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DISEASES *of the* CHEST

VOLUME XI

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NUMBER 1

INTRODUCTION

Symposium on Tracheobronchial Tuberculosis

The symposium on tracheobronchial tuberculosis which was presented at the annual meeting of the College is now being published in this issue. Its purpose is not only to acquaint the reader with the latest aspects of this disease but also, to direct and focus attention to this condition and thus invite further discussion and investigation. Not all of the answers are given in the following pages. Indeed, many are the problems before us that await the ingenuity of the pathologists, the clinicians, as well as the surgeons for their solution.

For instance, the pathologists could well inquire and investigate why 5 to 15 per cent of the patients develop tuberculous bronchitis and the remainder do not. Why is the disease more prevalent in women than it is in men? While some investigators, notably Cadden, Salkin and Edson, do not find a great discrepancy in the incidence between male and female, the majority of observers are impressed with the preponderance in females. The site of the lesions apparently also has a certain predilection. As shown by Silverman and Meissner, the distal small bronchi are the sites of the early lesions which later advance toward the larger bronchi. Wilson also points to the left main bronchus as the seat of greater involvement than that of the right. The clinician can certainly study much more closely the effect of aerodynamics caused by the physiopathological changes of endobronchitis, especially as it affects artificial pneumothorax therapy. The relationship of partial or complete bronchial obstruction to healing as well as to anaerobic infection, empyema, bronchial fistula, and closure of cavities, makes a fertile field for investigation.

Bronchoscopic diagnosis is still far from satisfactory as its field of vision is much too limited. The result of bronchoscopic treatment with silver nitrate awaits still further evaluation. The question of whether pneumothorax therapy, extensive thoracoplasty or resection is the treatment of choice will be the concern of clinicians, bronchoscopists and surgeons for years to come. One thing, however, is clear and that is that bronchoscopy forms an integral part of diagnosis and intelligent treatment of pulmonary tuberculosis. To this end, trained bronchoscopists especially interested in the field of tuberculosis must be a part of any well constituted staff of the sanatorium. There are still many sanatoria, either through neglect, or because they are situated away from medical centers, which remain without the benefit of such examinations. Is it too much to hope that the future chest specialist will not only be expert with his stethoscope, x-ray interpretations and clinical evaluation, but that he will also be adept with the bronchoscope?

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INTRODUCCION

Bronquitis Tuberculosa

Se publica en este número los comentarios sobre la bronquitis tuberculosa presentados durante la reunión anual del Colegio. Su propósito no es solamente el de familiarizar al lector con los aspectos más recientes de esta enfermedad, sino también el de dirigir y enfocar la atención hacia esta condición morbosa, y provocar de este modo más discusión e investigación. En las páginas siguientes no se dan todas las contestaciones, pues son muchos los problemas que se nos presentan cuyas soluciones aguardan la ingeniosidad tanto de los patólogos y clínicos como de los cirujanos.

Por ejemplo, los patólogos podrían inquirir e investigar por qué la bronquitis tuberculosa se desarrolla en del 5 al 15 por ciento de los pacientes y no en su totalidad. ¿Por qué la enfermedad prevalece más entre las mujeres que entre los hombres? Aunque algunos investigadores, especialmente Cadden, Salkin y Edson, no encuentran que exista gran discrepancia entre la incidencia en hombres y mujeres, la mayoría de los observadores sí notan la preponderancia de la enfermedad en las mujeres. Aparentemente la localización de las lesiones también manifiesta cierta predilección. Silverman y Meissner han demostrado que las lesiones más tempranas aparecen en los bronquios más pequeños y que después avanzan hacia los bronquios mayores. Wilson también indica que la invasión de la rama bronquial principal izquierda es mayor que la de la derecha. Es indudable que el clínico puede estudiar mucho más íntimamente, y con provecho, el efecto aerodinámico causado por las alteraciones fisis-patológicas de la endobronquitis, especialmente en lo que afecta al neumotórax artificial. La relación que guarda la obstrucción bronquial, completa o parcial, tanto con la curación como con la infección anaerobia, el empiema, la fistula bronquial, el cierre de cavernas, etc., presenta un campo fértil para la investigación.

El diagnóstico broncoscópico todavía deja mucho que desear, pues su campo de visión es demasiado limitado. El resultado del tratamiento broncoscópico con nitrato de plata no puede todavía ser justipreciado definitivamente. El problema de si el tratamiento de elección es el neumotórax artificial, la toracoplastia extensa o la resección, ocupará a los clínicos, broncoscopistas y cirujanos por muchos años. Empero, hay una cosa clara, y es que la broncoscopia constituye parte integral del diagnóstico y del tratamiento inteligente de la tuberculosis pulmonar. Con este fin, broncoscopistas expertos, interesados especialmente en la tuberculosis, deben formar parte del cuerpo médico de todo sanatorio bien constituido. Existen todavía muchos sanatorios que, ya por descuido o porque se encuentran situados lejos de centros médicos, no cuentan con las ventajas de estos exámenes. ¿Es, acaso, mucho esperar que el futuro especialista del pecho sea no solamente experto en el uso de su estetoscopio, en sus interpretaciones radiológicas y en su juicio clínico, sino también apto en el uso del broncoscopio?

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Tuberculosis of the Trachea and Major Bronchi*

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INTRODUCTION

Tuberculosis of the trachea and major bronchi has long been known to the pathologist. Detailed historical reviews have been given by Bugher, Littig, and Culp,¹ and by Wilber,² the references dating as far back as the beginning of the 19th century. Since post mortem examination of patients dying of tuberculosis may reveal lesions in every organ, it was to be expected that the trachea and bronchi would not go unscathed. The pathologist, therefore, accepted these lesions casually. With the advent of bronchoscopy, however, interest was stimulated, for it was realized that the presence of lesions in the trachea and bronchi would greatly influence the therapy and course of the pulmonary disease. The use of the bronchoscope and bronchography permitted the study of large series of cases, and, during the past decade, important contributions were made by Eloesser,³ Riggins,⁴ Myerson,⁵ Epstein and Ornstein,⁶ Samson,⁷ Barnwell, Littig and Culp,⁸ Warren, Hammond and Tuttle,⁹ Cohen and Wessler,¹⁰ Hawkins,¹¹ and others. Concomitant with this revival in clinical interest, detailed pathological reports began to appear, such as those by Reichle and Frost,¹² Bugher, Littig and Culp,¹ Auerbach,¹³ Wilber,² and Chia-Ssu Huang.¹⁴ A good comprehensive review of the entire subject was given by Jenks.¹⁵

MATERIAL STUDIED

This paper includes the study of 110 consecutive cases autopsied at Triboro Hospital for Tuberculosis, with death due to tuberculosis. All had tuberculosis in the lungs.

Routine microscopic sections were taken in every case from the anterior and posterior wall of the trachea, the carina, and both main bronchi. In addition, any grossly suspicious area was studied microscopically.

Of the cases studied, 94 were white, 13 Negro, 2 Puerto Rican, and 1 Malayan.

83 were male, 27 female.

The age range was from 20 to 70 years.

PATHOLOGY

Gross and microscopic lesions found in the trachea and the main bronchi were both specific and non-specific. The specific lesions

*Read before the Tenth Annual Meeting, American College of Chest Physicians, Chicago, Illinois, June 12, 1944.

represented varying degrees of exudative, caseous, proliferative and fibrotic tuberculosis and could occur in any combination in the one tracheobronchial tree. The following are the types of lesions seen:

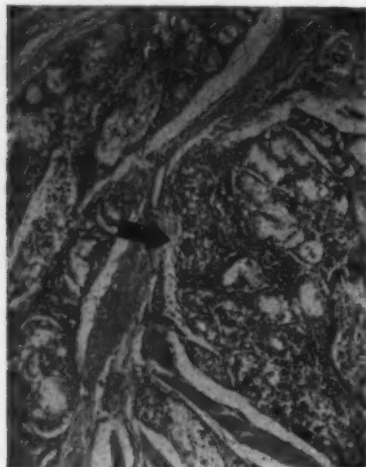


Figure 1

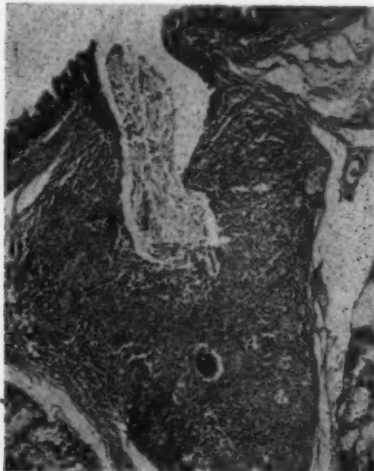


Figure 2

Figure 1: Trachea with grossly reddened and granular mucosa. Minimal specific lesion is represented by a small tubercle situated between the glands.—*Figure 2:* Trachea. Tubercle surrounding gland duct.



Figure 3: Shallow superficial tuberculous ulcerations on anterior wall of trachea.

1) Diffuse reddening and edematous thickening of the mucosal lining. Microscopic examination revealed congestion, and a dense lymphocytic infiltration. This was considered non-specific. It frequently accompanied specific lesions.

2) Small microscopic tubercles. These were situated between the glands, surrounded the gland ducts, or were found immediately beneath the epithelium (Figs 1 and 2).

3) Shallow microscopic ulcerations with denudation of the mucosal epithelium, and a lymphocytic infiltration in the base. A few of these, when stained for tubercle bacilli, revealed numerous acid-



Figure 4: Arrows point to the severe ulceration on the posterior wall of the lower portion of the trachea. This is the site of predilection.

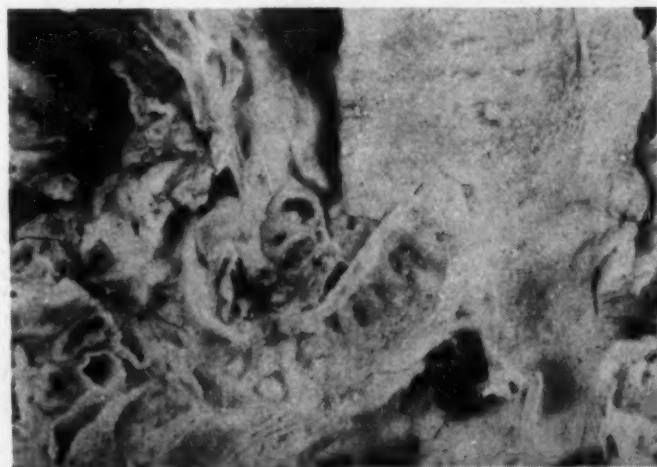


Figure 5: Severe tuberculosis of trachea, main bronchi, left upper lobar bronchus, and branches to cavity, with deep ulceration and extension to cartilage.

fast organisms in the ulcer base. If, however, no more specific histological lesion was seen, they were not included in this series, though some were probably tuberculous ulcerations.

4) Shallow microscopic ulcers with tuberculous granulation tissue in the base.

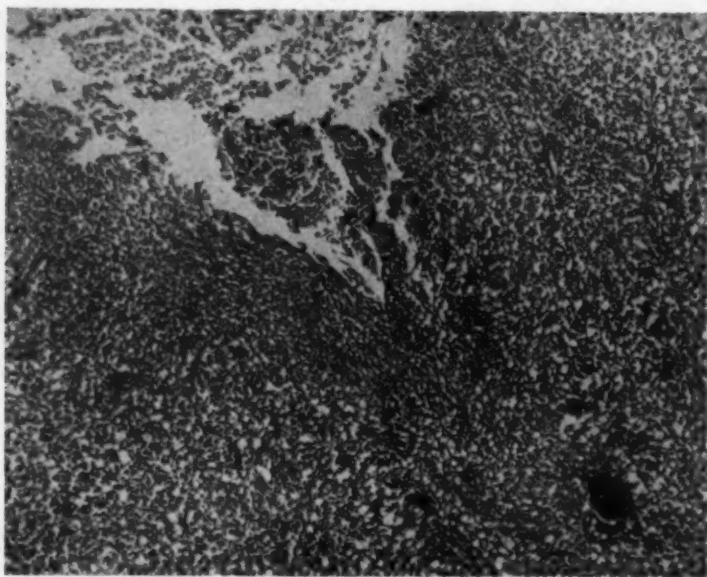


Figure 6: Tracheal ulceration with caseous base delimited by tuberculous granulation tissue.

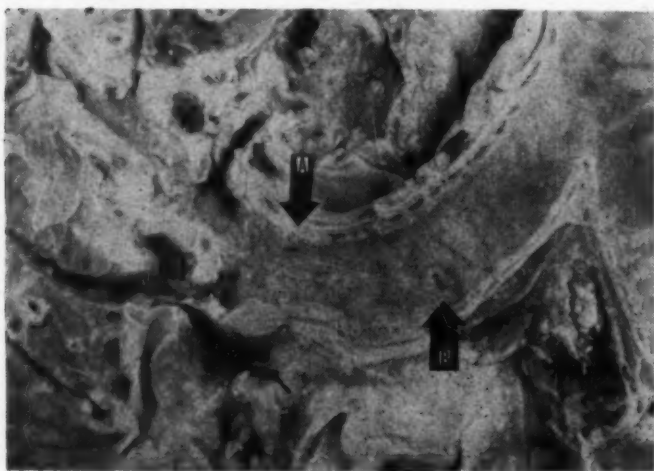


Figure 7: Ulceration, tuberculous granulation tissue, with some fibrosis, and narrowing seen in lower end of the left main bronchus (A) and lobar bronchus leading to cavity. A single ulcer is also present in the left main bronchus (B). Case with large left upper lobe cavity and left bronchopleural fistula.

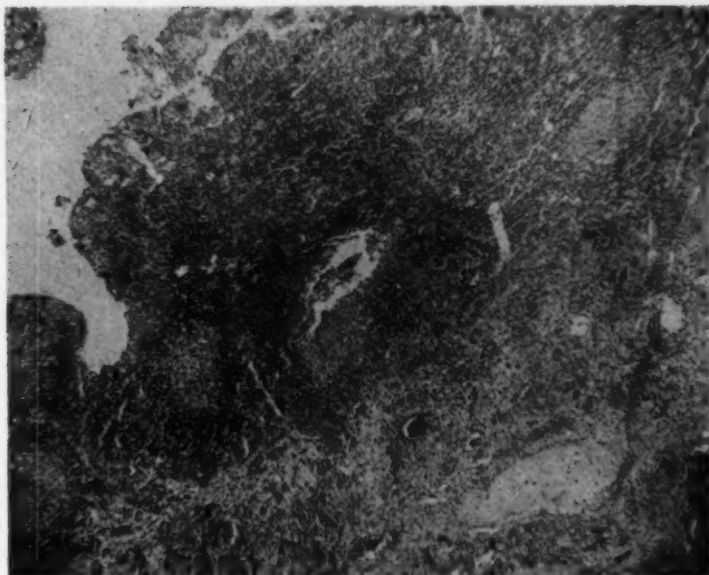


Figure 8: Wall of left upper lobe bronchus leading to left upper lobe cavity. Ulceration, congestion, tuberculous granulation tissue, fibrosis.



Figure 9: Congested coarsened mucosa with diffuse thickening of walls of trachea and bronchial tree. Some old scarring in right main bronchus.

5) Gross ulcerations, with tuberculous granulation tissue in the base. In the trachea these were most severe in the lower portion and on the posterior wall. The ulcers were few and shallow, or numerous, confluent, very extensive, at times eroding the cartilage (Figs. 3, 4, 5, 6).

This was the most frequent finding.

6) Ulceration with extensive tuberculous granulation tissue, accompanied by fibrosis, and leading to some narrowing of the lumen. The degree of fibrosis was usually not marked in the trachea, and was more appreciable in the main bronchi. Only in the branches of the main bronchi, draining tuberculous cavities, could this lesion be seen to any advanced degree (Figs. 7, 8).

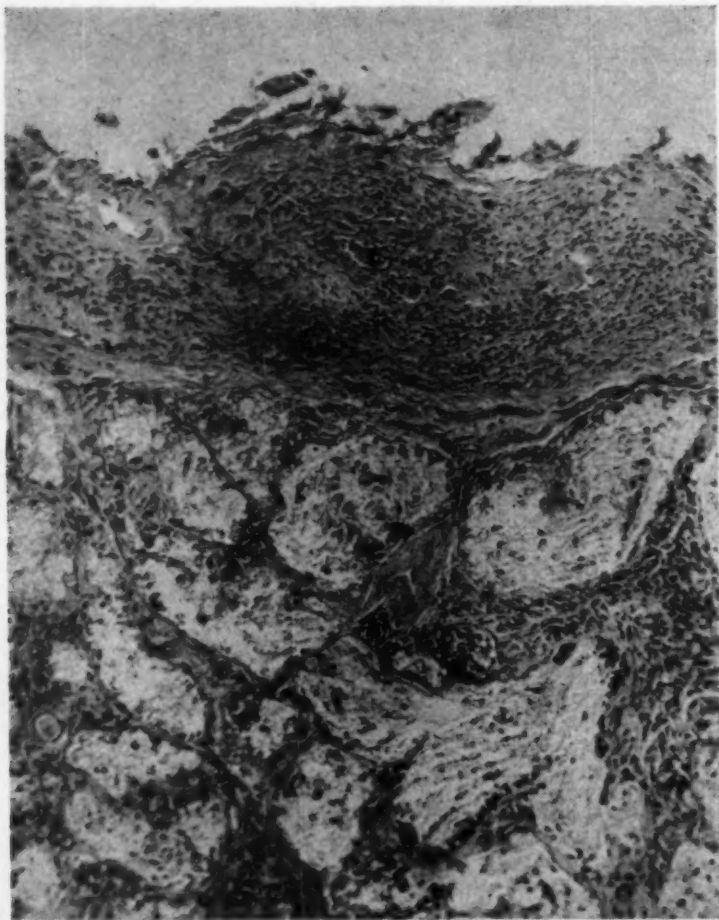


Figure 10: Left main bronchus with proliferative submucosal tubercle. This section also shows diffuse fibrosis of the wall of the bronchus.

7) Diffuse fibrotic thickening of the bronchial wall, with some narrowing, and the presence of superficial or submucosal tubercles. This, also, was not seen to as an advanced degree in trachea or main bronchi, as in their branches (Figs. 9, 10).

8) Scarring due to healing. No such lesion was noted in the trachea. It was recognized infrequently in the main bronchi (Fig. 11). Only in the branches of the lobar bronchi, draining tuberculous cavities, was complete occlusion due to healing and fibrosis seen.

No sharp line can be drawn between any of the above specific lesions since they are simply gradations of the same process.

INCIDENCE

In the 110 cases studied, 66 were found to have tuberculosis of the trachea and/or one or both of the main bronchi, an incidence of 60 per cent. It was apparent that the more detailed the histological examination the more frequent the positive cases.

There was no noteworthy predisposition in any one sex, race, or age group.

The cases could be subdivided, somewhat arbitrarily, as follows. We repeat, only the trachea and the main bronchi down to their subdivisions into the lobar bronchi are included in the following figures.

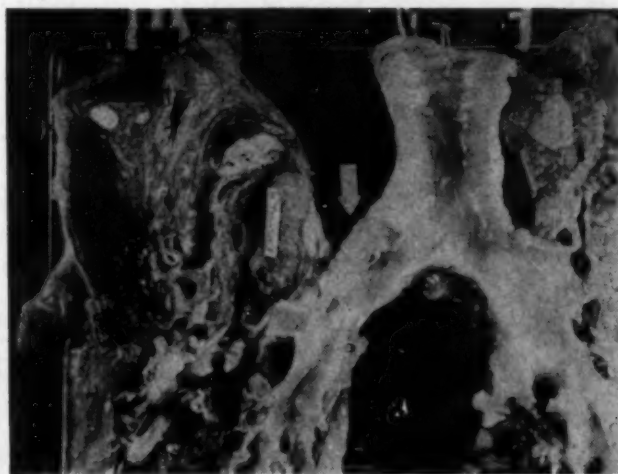


Figure 11: Scarring in the left main bronchus, end result of tuberculosis. Wall in region of the scar is thin and no active tuberculosis was present at this site. Case with inspissated cavity in left upper lobe and complete fibrotic occlusion of draining bronchus.

1) Cases with medium-sized to huge pulmonary cavities, without broncho-pleural fistulae (69):

- 33 had gross ulcerations
- 2 had gross submucosal tubercles
- 14 had only microscopic lesions
- 20 had no lesions

Incidence 71%

2) Cases with medium-sized to huge pulmonary cavities, with broncho-pleural fistulae (13):

- 4 had gross ulcerations
- 1 had gross submucosal tubercles
- 4 had only microscopic lesions
- 1 had healed scarring
- 3 had non-specific microscopic ulcerations

Incidence approximately 70%

3) Cases with small pulmonary cavities (18):

- 1 had a few small ulcerations
- 2 had only microscopic lesions
- 15 had no lesions

Incidence approximately 17%

4) Cases with pulmonary silico-tuberculosis (3):

- (a) with extensive cavitation
 - 1 had gross ulcerations
 - 1 had thickening and gross submucosal tubercles
- (b) without extensive cavitation
 - 1 had no lesions

5) Cases with predominantly miliary hematogenous dissemination in the lungs (7):

- (a) with small cavity formation
 - 2 had only microscopic lesions
(including Case 2, quoted below)
- (b) without cavity formation
 - 1 had only microscopic lesions
(Case 3, quoted below)
 - 4 had no lesions

It can be seen, from the above figures on incidence, that lesions in the trachea and main bronchi were most frequent in cases having large pulmonary cavities, including those with broncho-pleural fistulae.

PATHOGENESIS

Primary tuberculosis of the trachea and main bronchi must be extremely rare. The lesions are usually secondary and may be due to:

- 1) Direct surface implantation with the tubercle bacilli.
- 2) Direct extension from neighboring tuberculous tissue, e.g., lymph nodes.
- 3) Bacilli brought from other foci via lymphogenous or hematogenous routes.

1) *Direct surface implantation with the tubercle bacilli.* Tuberculous lesions in the trachea and main bronchi were most frequent in cases having large pulmonary cavities, including those with bronchopleural fistulae. It is in these cases that the quantity of bacilli-laden sputum is most abundant. Direct surface implantation would, therefore, appear to be the most obvious mode of infection. Reichle and Frost,¹² state that the defensive barriers of the bronchi, viz. cilia, mucous glands, and bronchial epithelium prevent this type of infection. However, the constant irritation of an abundant sputum, and, as in the cases of broncho-pleural fistulae, an immobile lung with a mixed infection, should readily break down these barriers. The non-specific ulcerations found, particularly, in the cases with broncho-pleural fistulae, suggest a devitalization of the surface with implantation of numerous tubercle bacilli in the ulcer base.

2) *Direct extension from neighboring tuberculous tissue.* Direct extension from neighboring caseous lymph nodes has frequently been reported. One case autopsied at Triboro Hospital during the past year showed such extension into the right middle lobe bronchus.

One of the causes of bronchial stenosis may be the erosion of the bronchial wall by an old calcified tuberculous lymph node. This has been recognized clinically, and at the autopsy table. One such case is included in Cohen and Wessler's series.¹⁰ The following report illustrates what is probably the late result of such an occurrence.

Case 1. A-104. A 59 year old white female had contracted pulmonary tuberculosis 20 years ago. It apparently had been readily controlled and arrested. A year before her death a radical mastectomy was done for carcinoma of the breast. Subsequent to this, she developed active pulmonary tuberculosis and was admitted with extensive cavitation throughout the right side. Autopsy revealed a diverticulum of the right main bronchus, 1 cm. in size, and 7 mm. deep. Its base was formed by an anthraco-fibrotic lymph node (Fig. 12).

It seems reasonable to postulate that there had been, at one time, erosion of the bronchial wall by the neighboring lymph nodes possibly with the extrusion of calcified particles.

3) *Bacilli brought from other foci via lymphogenous or hematogenous routes.* No indisputable case due to the transport of organisms via lymphatics or blood vessels was noted. The following two reports illustrate cases with miliary hematogenous dissemination in the lung in which lesions of the trachea or main bronchi were found.

Case 2. With Single Cavity Formation. A-86. A 34 year old white male died with generalized lympho-hematogenous tuberculosis, and a miliary dissemination in the lungs. The sputum concentrates were negative. The last sputum examined showed 1 colony on culture.

At autopsy the lungs revealed a miliary dissemination. One caseous right paratracheal lymph node eroded into the right upper lobe with resultant small cavity formation. The bronchus draining this cavity showed tuberculosis in its wall. Microscopic examination of the main bronchi at the carina revealed the presence of a small isolated tubercle between the glands (Fig. 13-a). The lymph nodes below the carina were caseous, and erosion of the cartilage by direct extension from the underlying tuberculous tissue could be seen (Fig. 13-b).

In spite of the fact that the general pathogenesis in the case is one of lympho-hematogenous dissemination, and that some direct extension from the underlying lymph node was seen, the submucosal tubercle may still be due to surface implantation with the tubercle bacilli. The source of the bacilli would be the pulmonary cavity.

Case 3. Without Cavity Formation. A-51. A 27 year old white female



Figure 12: (Case 1). Large diverticulum in right main bronchus probably due to old erosion of wall from underlying lymph node. The base of diverticulum is formed by anthraco-fibrotic lymph node.

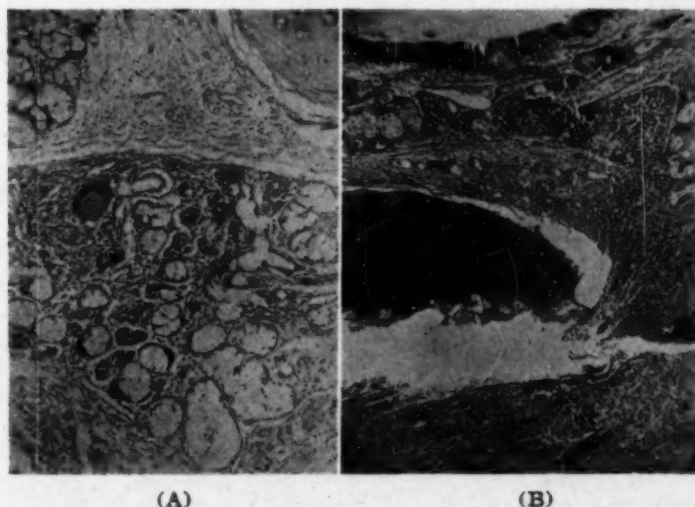
died with generalized lympho-hematogenous tuberculosis and a miliary dissemination in lung. Sputum was positive, Gaffky 2.

At autopsy the lungs revealed a miliary dissemination without any cavity formation. Microscopic examination showed extensive tuberculosis in the walls of the small bronchi, with denudation of the mucosa. Microscopic examination of the trachea and main bronchi revealed one superficial ulceration in the left main bronchus (Fig. 14). The lymph nodes showed caseous tuberculosis.

Here, again, in spite of the fact that the general pathogenesis in this case was one of lympho-hematogenous dissemination, the superficial isolated ulcer in the left main bronchus, may still be due to surface implantation with tubercle bacilli. The severe tuberculosis in the small bronchi afforded ample source for the bacilli.

TUBERCULOSIS OF BRONCHI DRAINING CAVITIES AND ITS RELATIONSHIP TO TUBERCULOSIS OF TRACHEA AND MAIN BRONCHI

The high incidence of severe tuberculosis of the lobar bronchi and those branches which drain cavities is an important fact favoring the theory of implantation mode of infection. Direct extension from neighboring tuberculous tissue is also readily afforded in these bronchi. Though an intensive investigation of the bronchi draining cavities was not made in this study, it was evident that bronchial tuberculosis was almost constant and most advanced in this group. Many cases showed the process to diminish in severity as the main bronchi and trachea were approached (Fig. 7). In other words, lesions of trachea and main bronchi are usually later lesions in the course of pulmonary tuberculosis and, therefore, apt to be less advanced.



(A) (B)
Figure 13: (Case 2). Section at carina. (A) Small isolated tubercle between the glands. (B) Erosion of cartilage by direct extension from underlying caseous lymph node.

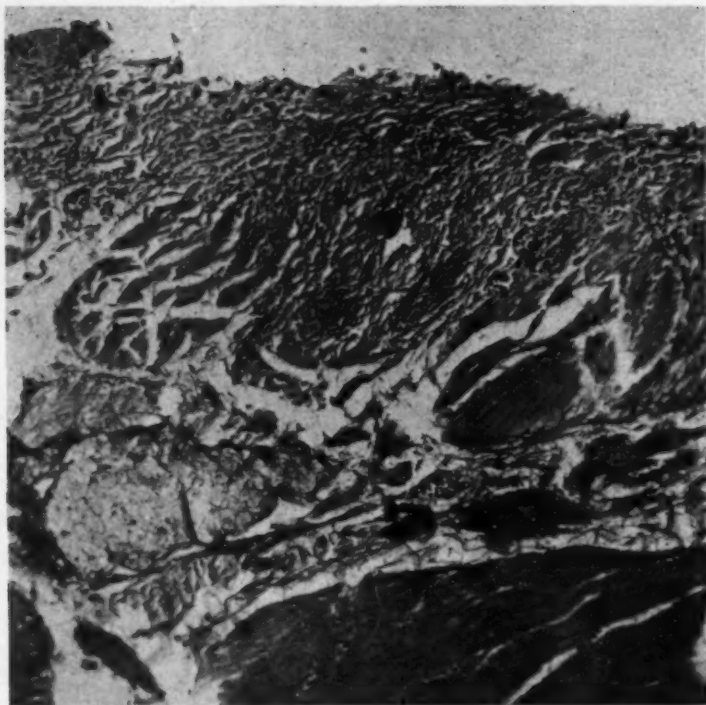


Figure 14: (Case 3). Superficial tuberculous ulceration present in left main bronchus. Miliary dissemination in lungs. Tuberculosis of the small bronchi. No cavity formation.



Figure 15: Tuberculosis of larynx and trachea. Major involvement of the trachea is in the portion just below the larynx.

LARYNGEAL TUBERCULOSIS AND TUBERCULOSIS OF TRACHEA AND MAIN BRONCHI

The larynx was examined, grossly and microscopically, in 95 of the 110 cases studied.

Of these, 54 had tuberculosis of the larynx, an incidence of about 57 per cent.

Of the 54 cases with laryngeal tuberculosis, 13 had no tuberculosis of the trachea or main bronchi.

On the other hand, 18 cases with a negative larynx had tracheo-bronchial tuberculosis.

Therefore, there is no direct correlation between laryngeal and tracheo-bronchial tuberculosis. Only occasionally was the tuberculosis of the trachea most severe in its upper portion, below the larynx, where downward extension may have occurred (Fig. 15).

Both the laryngeal and the tracheo-bronchial tuberculosis appear to be dependent on the pulmonary lesions.

DISCUSSION

The results of this study tend to confirm the findings of the majority of investigators.

One of the confusing points in the literature is the application of the term "major bronchi." Observations and conclusions based on the study of only the right main bronchus and the left main bronchus must of necessity differ from those studies which include the lobar bronchi and their subdivisions.

Investigation of only the trachea and main bronchi is an inadequate approach to the subject. Close correlation with the findings in the rest of the bronchial tree and the case as a whole is necessary.

Autopsy findings and percentages obviously cannot coincide with clinical investigations. The bronchoscopist is limited to gross inspection and the study of biopsy fragments. Non-specific reactions, such as congestion and edema, will be pronounced in the living state, whereas the small specific tubercle and ulceration will not be discerned. On the other hand, post mortem examinations have their own limitations. Cases with bronchial tuberculosis and minimal pulmonary tuberculosis are not seen by the pathologist. Autopsy studies will reveal clinical tracheo-bronchial tuberculosis overshadowed by terminal lesions, or only terminal manifestations. Some of the microscopic tubercles or shallow specific ulcerations may be lesions which occurred just before death. Clarification of the problem can only be obtained by closely correlated clinical and pathological studies.

Unquestionably the surface implantation, direct extension, lymphogenous, and hematogenous modes of infection can all play a

part in the pathogenesis of tracheo-bronchial tuberculosis. The most common mode of infection appears to be surface implantation with the tubercle bacilli.

SUMMARY AND CONCLUSIONS

Tuberculosis of the trachea and both main bronchi is a frequent finding in post-mortem examinations of patients dying of tuberculosis.

Tuberculous ulcerations are the most common lesions. Microscopic lesions help to swell the positive figures.

Thickening due to tuberculous granulation tissue and fibrosis, with resultant stenosis, is an infrequent autopsy finding in the trachea, is occasionally noted in the main bronchi, but is often seen to an advanced degree in the bronchi draining the cavities.

Tracheo-bronchial tuberculosis is most common in those cases with large pulmonary cavities and is probably due to surface implantation with the tubercle bacilli.

The presence of tracheal or main bronchial tuberculosis usually signifies tuberculosis of greater severity within the lungs.

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Resumen y Conclusiones

Tuberculosis de la tráquea y de ambas ramas bronquiales principales es hallazgo frecuente en las autopsias de pacientes que han muerto de tuberculosis.

Las lesiones más comunes son las ulceraciones tuberculosas. Lesiones microscópicas aumentan las cifras positivas.

Engrosamiento debido a tejido de granulación tuberculoso y fibrosis, con la estenosis resultante, es un hallazgo autopsico que es raro en la tráquea y que sólo ocurre ocasionalmente en las ramas bronquiales principales, pero que se observa frecuentemente en un grado avanzado en los bronquios que desaguan las cavernas.

La tuberculosis tráqueo-bronquial es más común en los casos con grandes cavernas pulmonares y es probablemente causada por siembras de bacilos tuberculosos en la superficie.

La presencia de tuberculosis de la tráquea o de las ramas bronquiales principales generalmente indica tuberculosis intrapulmonar de mayor gravedad.

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Surgical Pathology of Endobronchial Tuberculosis**

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An additional approach to the study of the pathology of endobronchial tuberculosis has been provided by an opportunity to examine lungs surgically removed for pulmonary tuberculosis. There has recently been an increased realization of the frequency and importance of tuberculosis of the larger bronchi, which makes it essential that the pathology and pathogenesis of this condition be understood as completely as possible. The formation of the tuberculous ulcer of the bronchial mucosa and the genesis of the granulomatous and fibrous stenosis of the bronchial lumen have been discussed by Reichle and Frost,¹ Bugher, Littig and Culp,² Myerson,³ Wilber,⁴ and others. However, most of these studies have been made on necropsy material in which there was often widespread fatal disease. A study of this condition in specimens taken from living patients may help clarify some aspects of the problem and assist the surgeon in the evaluation of his cases of pulmonary tuberculosis from the standpoint of lung resection.

The general pathology of endobronchial tuberculosis has been described in the references noted and is discussed in Silverman's paper in this issue. Therefore, the scope of this paper will be limited to the consideration of certain aspects of the surgical pathology of this lesion. Of particular interest are such problems as the state of the secondary bronchi when a lobar or a mainstem bronchus is involved, the role of parenchymal tuberculosis as the exciting factor of the endobronchial lesion, and the duration and type of this parenchymal lesion. The incidence and extent of involvement of the hilar lymph nodes when endobronchial disease is present is of particular concern to the surgeon in determining the feasibility of lung resection.

MATERIAL AND METHODS

The material for this study consisted of 60 lungs or lobes of lungs which were resected by Dr. Richard H. Overholt and associates. The resection was done for various indications, which are discussed elsewhere,⁵ but all were performed as a method of treatment of pulmonary tuberculosis.

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Prior to pathologic examination and dissection, the lungs were fixed in 10 per cent formalin. Fixation included the intrabronchial injection under low pressure of 10 per cent formalin. Blocks for microscopic study were taken, as far as possible, from all main, lobar, and segmental bronchi, from parenchymal lesions, and from at least three hilar lymph nodes. In some cases serial blocks of various bronchi were taken. The sections were stained with hematoxylin and eosin. Acid-fast stains were done where thought necessary.

By this method of examination, tuberculous endobronchitis was found in the main stem, lobar, or segmental bronchi in 31 or about half of the cases. It is these 31 cases with which this report is primarily concerned.

RESULTS

The results of the study of the 31 cases showing endobronchial disease are summarized in Table I.

It should be pointed out that emphasis cannot be placed on these figures from a statistical point of view. This is not only because the series is not large enough, but also because the cases were selected surgically and both the surgical indication and the type of disease present were too variable to permit statistical comparison. However, certain trends are obvious.

The age and sex distribution of this group is in conformity with the general impression of many observers. Females in the third and fourth decades were particularly affected.

The presence of positive sputum in all cases and the frequent

TABLE I

Part resected	left lung	15
	right lung	9
	lobe or lobes	7
Age	15-57 years	
	average 32 years	
Sex	females	24
	males	7
Sputum	positive	31
Bronchoscopy	endobronchial tuberculosis	15
Duration of symptoms	7 weeks to 11 years	
Bronchus involved	segmental	31
	lobar	21
	main stem	13
Hilar lymph nodes	tuberculosis	27
	inadequately examined	4
Cavities	present	20

bronchoscopic diagnosis of endobronchial tuberculosis are not surprising findings.

While the duration of symptoms of pulmonary tuberculosis varied from seven weeks to eleven years, one third of the patients had these symptoms for less than one year. This is significant since it shows that endobronchial lesions do not develop only in patients who have had symptoms of parenchymal disease over a long period. Endobronchial tuberculosis may be an early complication.

The bronchial lesion varied from an occasional tubercle in the mucosa, submucosa, or about the deeper parts of the mucous glands to the presence of stenosing tuberculous granulation tissue often completely replacing the mucosa and, at times, associated with fibrosis. All gradations were found between these two extremes (Figs. 1, 2, 3). The diagnosis of endobronchial tuberculosis was not made unless typical tubercles were found and if there was any doubt, acid-fast stains for tubercle bacilli were performed. When a section of bronchus showed only a few scattered tubercles, there was usually associated a slight submucosal edema and a scattering of plasma cells and lymphocytes in the submucosa, but rarely ulceration of the epithelium. Even with moderately extensive tuberculous involvement there was at times no ulceration of the overlying epithelium and when ulceration occurred it was focal and often superficial. With more severe involvement, tuberculous

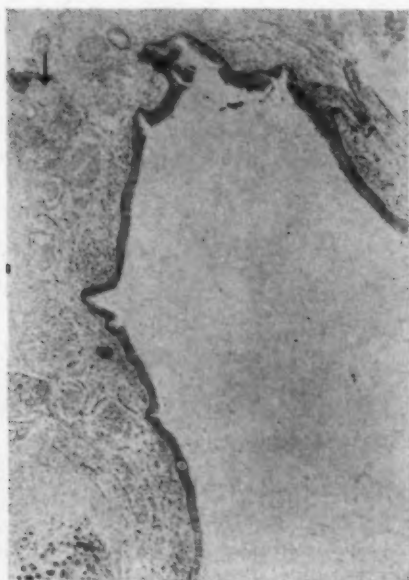


Figure 1



Figure 2

Fig. 1: Slight endobronchial tuberculosis. Note submucosal tubercles and tubercle near gland. (Hematoxylin and eosin, X 19).—*Fig. 2:* More advanced endobronchial tuberculosis with considerable cellular infiltrate. (Hematoxylin and eosin, X 19).

granulation tissue was formed which not only destroyed the epithelium but replaced the entire mucosa and submucosa and projected into the lumen so as to produce a stenosis.

There was apparent continuity of disease from the point of endobronchial tuberculosis nearest the hilum through the segmental bronchi to a parenchymal lesion. Thus, whenever there was tuberculous bronchitis of a main stem bronchus, it was also found in a lobar bronchus; when it was found in a lobar bronchus it was also present in one or more of its segmental bronchi. In spite of the apparent continuity of bronchial involvement, the severity of the disease varied considerably in different parts of the same bronchus or bronchial system. At times, a severe involvement of a lobar bronchus was found with only minimal lesions in its segmental bronchus; similarly a severe involvement of the mainstem bronchus was at times present with relatively little disease of the lobar and segmental bronchi. The interesting point is the involvement along the bronchus all the way to the parenchymal focus, although the disease seemed to manifest itself more severely in some areas along its course.

In 20 cases the parenchymal lesion from which the bronchial disease arose was a cavity; in the remainder it was a focus of caseation of varying size and age. A discussion of the condition

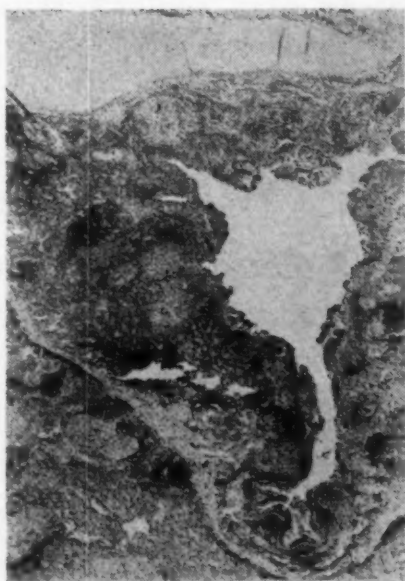


Figure 3



Figure 4

Fig. 3: Marked endobronchial tuberculosis with destruction of mucosa. (Hematoxylin and eosin. X 19).—*Fig. 4:* Hilar lymph node with typical extent of tuberculous involvement. (Hematoxylin and eosin. X 24).

of the rest of the parenchyma distal to the bronchial lesions is not included in the present study.

In 27 of the 31 cases it was possible to examine three or more of the hilar lymph nodes microscopically. In each of these 27 cases at least one and usually several lymph nodes showed tuberculosis. The extent of the disease was slight, only in one instance was there caseation. The common picture was a scattering of more or less discrete tubercles (Fig. 4). There was never any suggestion of direct extension of disease from the lymph node to the bronchus.

COMMENT

From the results of this study it appears that tuberculosis of the larger bronchi is the result and a complication of parenchymal tuberculosis. It cannot yet be said which cases will develop endobronchial tuberculosis. The primary parenchymal focus may be large or small and is not necessarily a cavity. The most likely time of the development of endobronchial disease is unknown, since in this series it arose after either a short or a long duration of symptoms of pulmonary tuberculosis.

The observation of such frequent tuberculosis of the hilar lymph nodes (a similar involvement was also found in many of the cases showing no endobronchial disease), proves lymphatic drainage or extension of tubercle bacilli from the pulmonary focus to the hilum of the lung. This is not surprising since it is well known that tuberculosis often spreads by lymphatics. Many of the lymphatics

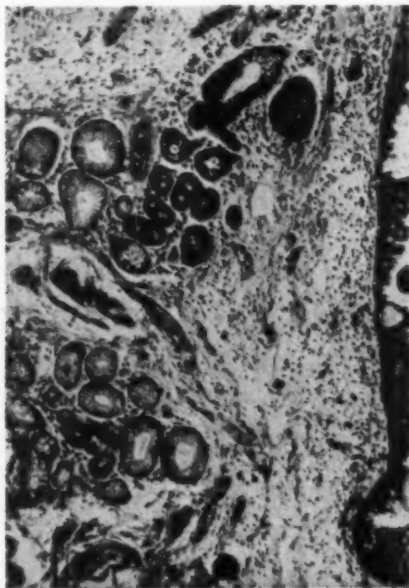


Fig. 5: Bronchial wall from a case of endobronchial tuberculosis to show prominent lymphatics. (Iron hematoxylin and eosin. X 55).

of the lung drain down the wall of the bronchus; the submucosa of the bronchus is also rich in lymphatics (Fig. 5). Thus, the entire course of a bronchus, including segmental, lobar and mainstem, which leads from a parenchymal lesion, is potentially subject to tuberculosis if the tubercle bacilli will but lodge in its wall. The area nearest the pulmonary disease is obviously more subject to infection which accounts for the greater incidence of involvement of segmental bronchi.

The earliest lesion found in tuberculous bronchitis consists of scattered tubercles, either in the mucosa, submucosa or about the mucous glands. The frequent involvement about the mucous glands has been pointed out by Reichle and Frost.¹ Such a slight bronchial infection may be a common accompaniment of pulmonary tuberculosis. However, the bronchus has such an ability to heal that even when superficial ulceration takes place, there is often not irreparable damage to the bronchial mucosa. Condon⁶ has shown that bronchial epithelium may regenerate rapidly if there is not too much damage to the submucosa. At times, whether because of more massive infection or decreased resistance, a tuberculous granulation tissue replaces the bronchial mucosa and submucosa and a stenosis results. Complete healing cannot then take place and scar tissue forms which, even if no longer tuberculous, still maintains a stenosis. An area of such severe endobronchial tuberculosis becomes independent of its parent parenchymal lesion and acts as a metastatic focus for further dissemination of tubercle bacilli. The area of extensive involvement is not necessarily diffuse, as pointed out, but may be limited to one or more foci in the bronchial system.

Infection of the bronchus by direct implantation of tubercle bacilli on the mucosa or in the crypts of the mucous glands has been emphasized by Huang⁷ and others. The presence of positive sputum in all cases in this series would seem to confirm this view if it were not for the fact that bronchial disease itself may give rise to positive sputum. Such an implantation infection may well occur, but it was not possible from this study to estimate its incidence. Even if the mucosa is infected by implantation, the submucosal lymphatics described above still remain an important factor in the subsequent spread of the disease.

Hematogenous bronchial infection and direct extension of parenchymal disease into a large bronchus are not generally thought to be frequent and were not the cause of endobronchial disease in this series. Epstein and Ornstein⁸ suggest that the bronchial infection occurs by extension from a tuberculous lymph node. This seems an unlikely mechanism in adult tuberculosis. In none of the cases of this series did this appear to be a contributing factor;

rather, the disease in both the lymph nodes and in the bronchus seemed more the result of the same lymphatic extension. While the hilar lymph nodes were frequently tuberculous, the involvement was of a slight degree.

SUMMARY AND CONCLUSIONS

- 1) A study of the bronchi of 60 lungs or lobes which were surgically resected for pulmonary tuberculosis showed tuberculosis of the larger bronchi in 31 of the cases.
- 2) Endobronchial tuberculosis is a condition secondary to parenchymal tuberculosis of the lung.
- 3) This parenchymal focus is of variable size and duration and is not necessarily a cavity.
- 4) Whenever parenchymal tuberculosis exists there is the potentiality of infection of the entire bronchial system leading from this area.
- 5) Different portions of the same bronchial system may be affected with varying severity.
- 6) Endobronchial tuberculosis may be present without epithelial ulceration.
- 7) The lymphatics of the bronchial wall play an important role in the infection of the bronchi and in the spread of the disease.
- 8) Tuberculosis of the hilar lymph nodes is a common finding when endobronchial tuberculosis is present but is of minor degree.

Resumen y Conclusiones

- 1) Un estudio de los bronquios de 60 pulmones o lóbulos que fueron extirpados quirúrgicamente por tuberculosis pulmonar, reveló tuberculosis de los bronquios mayores en 31 de los casos.
- 2) La tuberculosis endobronquial es un estado secundario a la tuberculosis del parénquima pulmonar.
- 3) Este foco en el parénquima es de tamaño y duración variables y no es necesariamente una caverna.
- 4) Cuandoquiera que haya tuberculosis del parénquima existe la posibilidad de infección del entero sistema bronquial de desagüe de esta zona.
- 5) La gravedad de las lesiones en diferentes partes del mismo sistema bronquial puede ser variable.
- 6) La tuberculosis endobronquial puede existir sin ulceración del epitelio.
- 7) Los vasos linfáticos de la pared bronquial desempeñan un papel importante en la infección de los bronquios y en la propagación de la enfermedad.

8) Tuberculosis de los ganglios linfáticos hiliares es un hallazgo común cuando existe tuberculosis endobronquial, pero es de grado menor.

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The Radiological Findings in Tracheo-Bronchial Tuberculosis**

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The existence of tuberculous lesions within the trachea and bronchi has been known for a long time, but it is only in the past five or six years that they have received much attention. This attention should be credited largely to Samson and others who made extensive studies of these lesions in the living subject by bronchoscopic examination.

At the post-mortem examination, endo-bronchial tuberculosis is commonly found in small and large bronchi near cavities which they drain, and less commonly at points distant from cavities. Wherever infected material remains long in contact with the mucous membrane of the bronchus, tuberculous lesions are likely to form, and the areas which are most exposed will naturally be those which are close to cavities, or in the small bronchi, where expulsion of the infected and often viscid excreted material is difficult. Main bronchi as well as the lower trachea may receive much excreted material from several cavities and smaller bronchi, and they are also common locations for tracheo-bronchial tuberculosis. The disease may be found anywhere in the trachea or bronchial system, but with the greatest frequency near cavities.

From microscopic study of this type of tuberculous lesion, we learn that the earliest or first lesion is a sub-epithelial tubercle. This tubercle may extend and grow by production of tuberculous granulation tissue until a tuberculoma has formed within the bronchus. Such tuberculomas vary in size from that of a pinhead to one large enough completely to occlude a bronchus. Other tubercles will extend and multiply along the bronchial mucosa with resulting necrosis and ulcerations. Such ulcerations are more common than the formation of tuberculomas and these ulcers may also vary in size from a very small, denuded area to a very large, undermined, ulcerated lesion. Many such tuberculous ulcerations will in time heal with scar tissue formation which contracts and produces stenosis, sometimes partial and, again, it may become complete.

It should also be remembered that the tracheo-bronchial system is not composed of tubes of a fixed caliber, but that the size of

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the lumen is definitely altered during the respiratory cycle. For this reason, an endo-bronchial lesion may be of such size as completely to occlude a bronchus during expiration but allow air to enter during inspiration.

Bronchoscopy is the method of choice at the present time, both for the finding and the treatment of the tracheo-bronchial lesion. In some hospitals for the tuberculous patient, all new admission cases have been bronchoscoped. From such examinations it has become possible to form a fair estimate of the incidence of this type of tuberculosis. In most hospitals it is quite impossible so to examine all new admissions and one must rely on the X-ray examination and physical findings in selecting the cases for bronchoscopy.

In this presentation, only the radiological findings suggesting endobronchial disease will be considered. It should be remembered that these findings will depend much upon the type and extent of the tracheo-bronchial lesion present. Some of these radiological findings have become so familiar to most of us that we are able to put a fair estimate on their worth. Others, less important indications, have similarly been discarded and will not be mentioned here.

For the sake of convenience we can divide these X-ray findings into two groups; namely, the direct signs such as we find in the

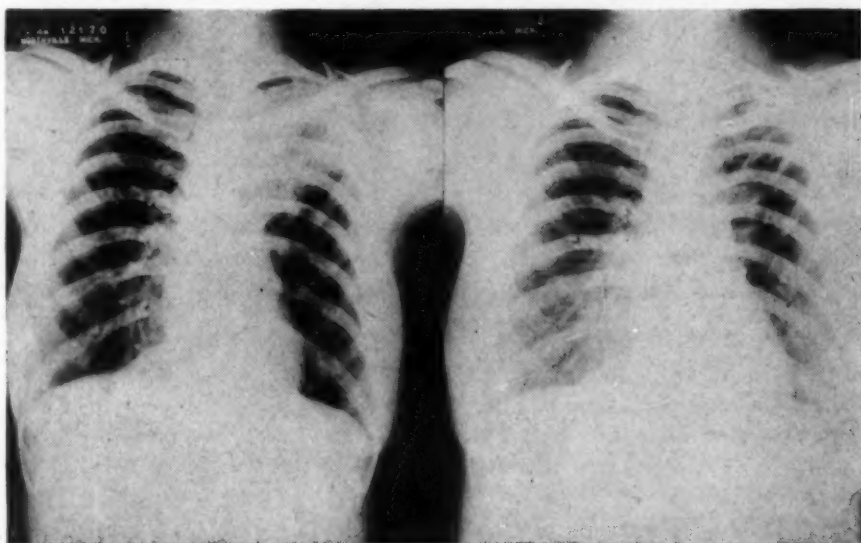


Fig. 1: 7-22-'42: No. 12170

Fig. 2: 4-14-'43: No. 12170

Fig. 1: Large area of consolidation in left upper lobe. Occlusion suspected. Bronchoscoped 7-30-'42 and stenosis of left main bronchus found.—Fig. 2: Same case as Fig. 1. Consolidation disappeared after treatment of bronchial lesion.

routine filming of the chest, and the indirect signs where we use the X-ray findings as well as certain clinical observations.

Direct signs:

1. Atelectasis.
2. Sudden consolidation of a lobe under collapse.
3. Sudden spread of a lesion apparently controlled.
4. Blocked cavity.
5. Far advanced disease.

Indirect signs:

1. Hemoptysis of the mild or streaking type, without demonstrable X-ray findings.
2. Positive sputum without demonstrable cavity.
3. Persistent non-productive cough.

ATELECTASIS:

In massive atelectasis mediastinal shift or elevation of the diaphragm on the affected side will occur, so that the condition is readily seen and bronchial obstruction invariably sought. But there are also small areas of atelectasis without visible mediastinal shift which are produced by occlusion of smaller bronchi. Such small atelectatic areas due to endo-bronchial disease are often found in the apical region of one or the other lung, and it is common practice to misjudge the size of the area involved in these

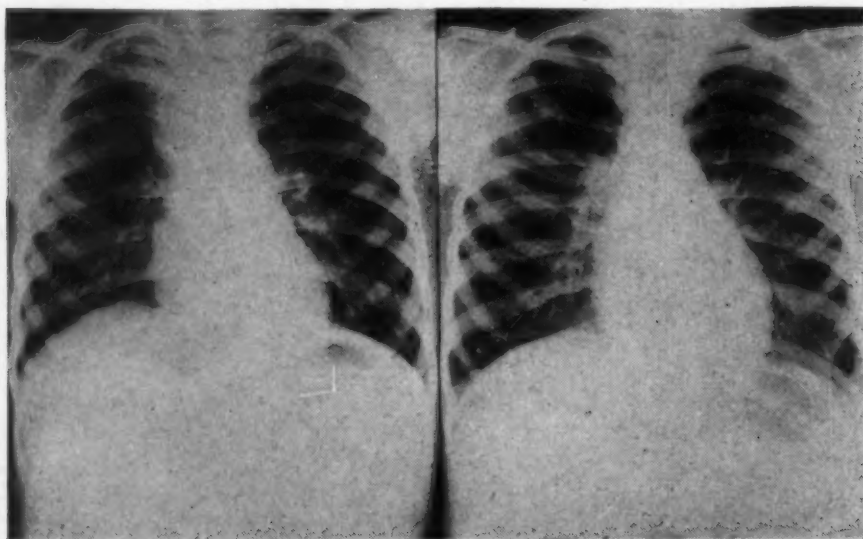


Fig. 3: 6-4-'38: No. 9040

Fig. 4: 6-30-'38: No. 9040

Fig. 3: Atelectatic area right upper lobe suspected in this patient with primary tuberculosis. Bronchoscoped 6-9-'38 and tuberculoma was found in right upper lobe bronchus.—Fig. 4: Same case as Fig. 3. After removal of tuberculoma, atelectatic area rapidly cleared.

regions. So, even if the signs of atelectasis are inconclusive, such areas should be investigated and the incidence of positive findings is sufficiently high to justify bronchoscopy.

In children with primary tuberculosis, where there is a large area of parenchymal disease, bronchial obstruction is very common. In such cases bronchoscopy should be done to determine if obstruction is due to pressure upon the bronchus by much enlarged mediastinal nodes or due to growth or ulceration within the bronchus. In one of our hospitals, several tuberculomas have been found in this way and with removal and treatment, the airways have been re-established with good results. Bronchoscopy of children is neither difficult nor dangerous and can be done at almost any age.

SUDDEN CONSOLIDATION OF A LOBE UNDER COLLAPSE:

Sudden consolidation of a lobe in a lung partially collapsed with pneumothorax is rather a common experience and it very often means bronchial occlusion. Sometimes this is produced by a clot of blood following hemoptysis, but it can also occur because of bronchial ulceration with some stenosis and it is a direct indication for bronchoscopy. From the X-ray findings alone, it is quite impossible to state the most likely cause. However, we do know that neither pneumothorax nor phrenic paralysis should be produced

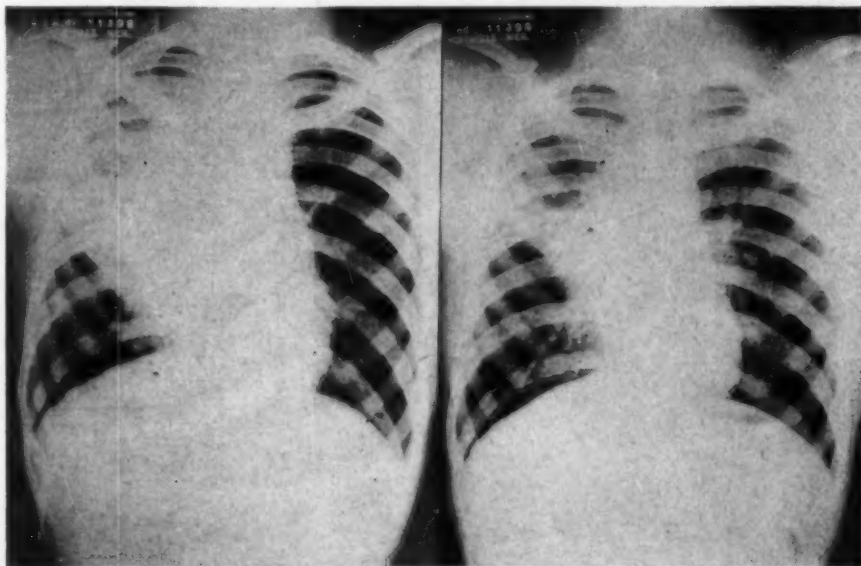


Fig. 5: 8-12-'41: No. 11398

Fig. 6: 1-7-'42: No. 11398

Fig. 5: Primary Tuberculosis. Bronchial obstruction suspected. Bronchoscoped 8-21-'41. Obstructive ulcer found in right upper lobe bronchus. Fig. 6: Same case as Fig. 5. After bronchoscopy and treatment of ulcerated area. Upper lobe is again aerated and original parenchymal lesion is now visible.

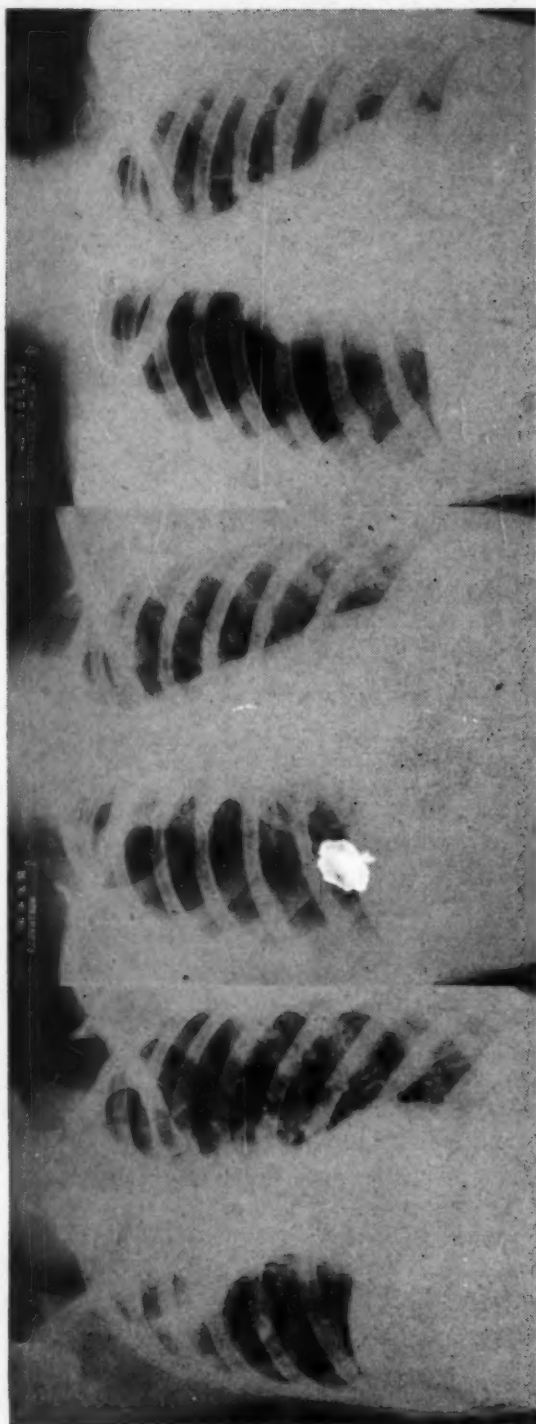


Fig. 7: 8-9-'38: No. 9181

Fig. 7: Failure of phrenic paralysis to effect size of cavity suggested bronchial obstruction. Bronchoscopy revealed extensive ulceration of right main bronchus.—Fig. 8: This patient had streaked sputum and no visible source for hemoptysis was found. Bronchoscopy revealed thickened hyperemic mucosa capable of producing streaked sputum.—Fig. 9: All cavities closed and sputum became positive. Bronchoscopy revealed diffuse tuberculous ulcerations in right main bronchus.

Fig. 8: 3-4-'39: No. 9260

Fig. 9: 3-4-'43: No. 10525

where there is any marked amount of stenosis of major stem bronchi, and for this reason, we believe that it might in time become necessary as a routine procedure to do bronchoscopy before inducing any appreciable amount of collapse therapy.

SUDDEN SPREAD OF A LESION APPARENTLY CONTROLLED:

In other patients we appear to have gained good control of the disease with pneumothorax or other collapse procedures. Sputum has been converted and remained negative for variable periods, when all of a sudden a spread occurs into other areas, frequently the contra-lateral lung. Such spreads we have often found in cases with endo-bronchial tuberculosis. One can easily imagine that the effect of such ulceration may, like an atomizer, spray most any part of either lung and easily start new foci. It should be considered as one of the signs to be looked for in check-up examinations and when found, bronchoscopy should be done.

BLOCKED CAVITY:

Sudden variations in size of cavities or a cavity with considerable fluid should be regarded as signs of insufficient drainage. In some, there is a ball-valve action, allowing air to enter but not to escape. In the other type, air will enter but there is not sufficient bronchial lumen for all of the cavity contents to escape or be

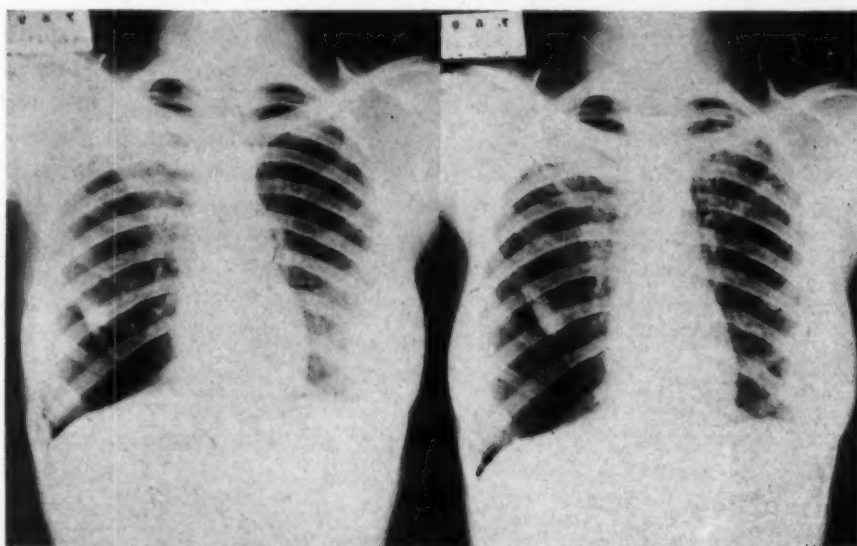


Fig. 10: 12-19-'36: No. 7696

Fig. 11: 5-14-'37: No. 7696

Fig. 10: Right pneumothorax closed cavity and disease is apparently under control.—Fig. 11: Same case as Fig. 10. New disease developed on the left side. Bronchoscopy revealed ulcer of right main bronchus.

expelled. Sometimes, this may be caused by stenosis as well as kinking of a bronchus, or again, it is caused by endo-bronchial tuberculosis such as a tuberculoma or a severe ulceration which will partly obstruct the bronchus. Failure of cavities to close or reduce in size following collapse measures, which should be adequate, indicates bronchial obstruction.

FAR ADVANCED DISEASE:

Lastly, in the consideration of the direct signs, one should always suspect endo-bronchial tuberculosis in all cases of far advanced tuberculosis, especially in the presence of multiple and bilateral excavations. In such cases, large areas of mucous membrane of the bronchial tree must be constantly exposed to infected, excreted material with resulting breakdown or tubercle formation.

INDIRECT X-RAY SIGNS:

1. Hemoptysis of the Mild or Streaking Type, Without Demonstrable X-Ray Findings:

Hemoptysis is uncommon in the non-ulcerating type of tuberculosis, unless there is an associated bronchiectasis. We also know that mushy and open ulcerative endo-bronchial tuberculosis is capable of eroding small blood vessels and thus cause bleeding. Such bleeding is usually not profuse but often just a slight ooze,

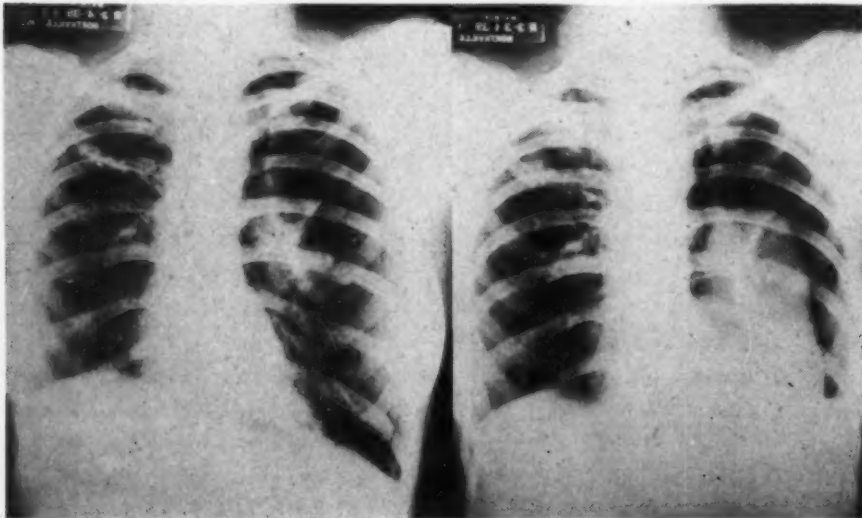


Fig. 12: 3-4-'39: No. 10122

Fig. 13: 3-31-'39: No. 10122

Fig. 12: Pneumothorax on the left with selective collapse of upper lobe and good aeration of lower lobe.—Fig. 13: Same case as Fig. 12. Sudden consolidation of left lower lobe suggested bronchial obstruction. Bronchoscopy revealed ulcer of left main stem bronchus with stenosis.

which will produce streaking of the sputum. When this occurs, it should serve as a reminder that such a condition might exist and be an indication for bronchoscopic investigation.

2. Positive Sputum Without Demonstrable Cavity:

Positive sputum, without demonstrable cavity, is not an uncommon experience of all radiologists. We first of all, look for small cavities in the apical areas where the ribs often get in our way. We next make oblique projections to rule out possible cavities hidden by the heart shadow. Sometimes it is necessary to make films with the patient on the Bucky diaphragm to penetrate a heavy pleura or dense fibrosis. Stereoscopic projections should always be made to decide whether a suspicious shadow is or is not a cavity. Planography is a very useful method for finding cavities, but it is seldom available. In a number of such cases where we failed to find cavities, bronchoscopy was done and endo-bronchial lesions were found, and after treatment of such lesions, sputum converted.

The finding of such lesions in this type of case has given the radiologist much confidence in his accepted standards of what he must see to interpret a cavity and differentiate it from blebs and similar ring-like shadows.

3. Persistent Non-Productive Cough:

Lastly, we find a patient whose cough is out of proportion to that necessary to evacuate any excreted material. It is usually a dry cough and the x-ray findings are minimal. Here one should expect endo-bronchial irritations as a cause for the cough and look for such disease with the bronchoscope.

With these signs, and findings, plus some physical signs, such as a wheeze, we have at one of our institutions examined 565 patients with the bronchoscope in the past five years and in this group, 148 cases of endo-bronchial disease were found. One hundred ninety-eight of these were examined routinely, prior to thoracoplasty and other collapse measures. A few others were examined because of certain peculiarities of distribution of the disease in the lungs, namely, a hilar flare; but this was given up because it yielded a very low incidence of positive findings. We believe that because of this five year experience, we have been able to exclude certain signs and justify others. However, a table of findings and interpreted signs is appended, as well as photographic reductions of typical cases in which endo-bronchial tuberculosis was found.

SUMMARY

1) A brief description of the common types of the tracheo-bronchial tuberculous lesion has been attempted in order to show the cause of variable radiologic signs of this disease.

2) A classification has been made of the important X-ray signs of possible tracheo-bronchial tuberculosis to serve as an indication for bronchoscopy.

Resumen

1) Se ha intentado describir sucintamente los tipos comunes de las lesiones tráqueo-bronquiales tuberculosas a fin de demostrar la causa de los variables signos radiológicos de esas lesiones.

2) Se ha formulado una clasificación de los signos radiológicos importantes de posible tuberculosis tráqueo-bronquial, para que sirva de indicación para la broncoscopia.

Bronchoscopic examinations made for all indications of tuberculous tracheo-bronchitis in the past 5 years at Maybury Sanatorium, show the following results:

	No. of Cases Bronchoscoped	No Findings	Ulceration or Stenosis Found
Prior to collapse (all types)	224	198	26
Suspected Tracheo-bronchial Disease:			
1. Wheeze	61	38	23
2. Positive sputum without cavity	103	61	42
3. Consolidation or atelectasis. (Includes: apparent atelectasis following collapse)	81	54	27
4. New Disease— Old under control	18	13	5
5. Source of hemoptysis	28	20	8
6. Other causes, such as hilar flare, excessive dyspnoea, etc., including also 3 cases with ulcerations originally bronchoscoped elsewhere	50	33	17
TOTAL	565	417	148

The authors are deeply grateful to Dr. W. L. Brosius for his collaboration and the use of his unusual postmortem material.

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Bronchoscopic Observations in Tuberculous Tracheobronchitis—Clinical and Pathological Correlation**

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During the past decade tuberculous tracheobronchitis has come to be recognized as one of the most common and most serious complications of pulmonary tuberculosis. Only in recent years has bronchoscopy been accepted as a safe diagnostic procedure in tuberculous patients. During this time it has played the leading role in establishing the high incidence and the true clinical significance of these lesions. Today, as the result of many excellent clinical and pathological studies,^{1,2,3,4,6,7,10,22,23,25} we know that the presence of endobronchial tuberculosis complicates the treatment and makes the prognosis of pulmonary tuberculosis much more serious. It is also an established fact that this complication can occur in any stage of the parenchymal disease. This is substantiated by the fairly high incidence of minimal lesions in almost all reported series. In fact in a few cases no parenchymal lesion has been found by means of x-ray. Because of these observations bronchoscopy has been used in an ever-increasing percentage of cases in recent years. In some institutions routine bronchoscopy is now performed on every patient admitted although the usual procedure is to bronchoscope only those with specific indications.

However, in spite of all the work and publications in the past decade a great many clinicians are still either not aware of the prominent role played by tuberculous bronchitis in determining the prognosis of their cases, or are failing to apply the known facts concerning this complication in outlining the therapy for their tuberculous patients. The bronchoscopist is reminded of this all too often by the large number of patients he examines who have tuberculous bronchitis and are collapse therapy failures with persisting positive sputum, uncontrolled symptoms, empyema, unexpandable lung, atelectasis, and anaerobic infection in the lung. The time has come when this complication must be considered a possibility in every patient with pulmonary tuberculosis. The bronchoscopist must cease to be a pure endoscopist and become a student of the disease process as a whole so that he, along with the clinician and the surgeon, working as a team, may arrive at the

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most intelligent and timely therapeutic approach in each individual case.

INCIDENCE

The incidence of tuberculous tracheobronchitis as revealed by routine bronchoscopic examination of patients on admission to sanatoria falls between 10 and 15 per cent.^{10,21} The work of Salkin, Cadden and Edson is especially interesting in that they found an incidence of 10 per cent at the time the patients were admitted to the sanatorium. During residence, however, an additional 5 per cent of their patients developed tracheobronchial lesions. This emphasizes the need for subsequent bronchoscopic examination in these patients when the clinical and x-ray indications are present. Of course, the incidence in patients referred for bronchoscopy because of specific symptoms, signs or x-ray findings, will be much higher. In this latter group the incidence will fall between 30 and 60 per cent depending upon how carefully they have been selected. In almost all reported series the preponderance of females (75 to 85 per cent) has been outstanding. In my own experience 72 per cent of the bronchial lesions have occurred in females. The work of Salkin, Cadden and Edson is an outstanding exception to this. They report that the sex of the patient is a factor of no importance in determining the incidence of these lesions.

The incidence and significance of tuberculous bronchitis in young children is just coming to light. The excellent work of Jones, Rafferty and Willis has pointed the way in this study. They have shown that 12 per cent of the children admitted to Maybury Sanatorium will present at some time or other the clinical picture of epituberculosis. They have bronchoscoped a number of these children and have found that 75 per cent of them have definite evidence of endobronchial tuberculosis, or bronchial occlusion due to glands. In fact, tuberculoma and erosion of caseous lymph nodes are seen predominantly in children and are rarely seen in adults.

Autopsy studies have revealed that tuberculous lesions of the trachea or major bronchi will occur in about 40 per cent of all cases.^{3,21}

PATHOGENESIS

CORRELATION OF PATHOLOGY AND BRONCHOSCOPIC OBSERVATIONS

During the past year Dr. William Meissner has studied the surgical pathology of 60 tuberculous lungs resected by Dr. Richard H. Overholt. In 31 of these lungs some degree of involvement of the major, lobar, or segmental bronchi has been demonstrated.

This has enabled the pathologist to study these bronchial lesions in all stages of development in contrast to autopsy studies where only far-advanced, terminal processes are available for examination. The following facts have been revealed by this painstaking piece of work:

- 1) The earliest bronchial lesions seen were submucosal tubercles and round cell infiltration. The findings have pointed more to a spread through the bronchial lymphatics than to surface implantation.

- 2) When tuberculous bronchitis is present in the main bronchus a lobar bronchus is always involved and the involvement extends to a parenchymal lesion, not necessarily a cavity.

- 3) Tuberculous ulceration may take place anywhere along the involved segment of the bronchus.

- 4) Once established, the bronchial tuberculosis seems to be a self-propagating affair and does not then depend entirely on the activity of the parenchymal lesion. In fact, just the reverse seems to be true in many instances.

Although a discussion of surgical pathology does not fall within the realm of this paper its correlation with bronchoscopic findings, as follows, is of extreme importance.

The earliest bronchial lesions seen by bronchoscopy are likewise of the submucosal type. In the early stages they are usually localized around one of the bronchial orifices and represent an extension to the main bronchus from this bronchial division. The posterior half of the bronchus is more frequently the site of involvement than the anterior half. The mucosa is granular and reddened. The bronchial wall is indurated and edematous so that the cartilaginous rings do not stand out normally or may be entirely obliterated. Submucosal nodulation, representing tubercles, may or may not be seen. Some degree of narrowing of the main bronchus is usually present, but as a rule at this stage the main bronchus has an adequate airway. This type of involvement may remain localized around one of the bronchial orifices or it may become so extensive as to involve the entire main bronchus and extend into the trachea. Usually by this time ulceration and granulation tissue are evident and indicate that the bronchial tuberculosis has eroded through the mucosa and now represents an open focus which is disseminating tubercle bacilli. Also the hyperplastic changes in the bronchial wall become more marked and the cartilages may become involved, as is evident by the increased mobility of the bronchial wall. It is important to realize that ulceration may occur early or late and at any point along the involved portion of the bronchus. The presence of granulation tissue is accepted as evidence of underlying ulceration. The bron-

chial ulcers vary greatly in size. As a rule they are quite small, but multiple. Occasionally an isolated ulcer is seen with very little evidence of surrounding involvement of the bronchus. Some of these may be due to surface implantation. The ulcers usually have irregular edges and the base is often covered with a grayish exudate. In time the processes of healing become evident. I do not wish to imply here, however, that complete healing is the usual occurrence. At this phase the processes of scarring and of activity of the lesions may coexist. The submucosal type of involvement during the healing process shows progressively less inflammatory reaction and less edema and the mucosa becomes less granular and friable. The isolated ulcer heals with very little evidence of scarring. In that portion of the bronchial wall where tissue destruction has been marked, stenosis will eventually appear as a result of fibrosis. The degree of stenosis will depend upon the extent of tissue destruction and its occurrence can usually be predicted by the bronchoscopist by the character of the pre-existing lesion. Stenosis is most likely to occur in areas involved by extensive ulcerative and hyperplastic changes. It may be of the smooth fibrous type or there may be residual ulceration of the mucosa associated with fibrous stenosis of the bronchial wall. The healing of a bronchial lesion requires considerable time and bronchoscopic evidence in the form of a granular, friable mucosa with some underlying induration may remain for several months.

Thus, there are essentially three stages of tuberculous bronchitis: (1) submucosal infiltration; (2) ulceration and hyperplastic changes; (3) healing. These can, and usually do, coexist. Healing may occur at any stage.

In spite of the fact that all evidence points to the extension of tuberculous bronchitis from the periphery to the central portion of the bronchial tree, the ultimate stenoses apparently tend to involve some portions much more often than others. Why this should be is unexplained. In a study of 36 consecutive cases of stenosis it was found that 20, or 55.5 per cent of them involved the left main bronchus and that eleven, or 30.5 per cent of them involved the orifice of the right upper lobe. These figures substantiate a clinical impression which has revealed that on the left side stenotic lesions of the main bronchus are frequently seen, whereas those of the upper lobe bronchus and the lower lobe bronchus below the superior division are uncommon. On the right side stenotic lesions involving the main bronchus near its orifice have been, in my experience, very unusual, whereas those involving the right upper lobe orifice have been very common. This predilection of stenotic lesions for those locations is interpreted to mean that more destruction of the bronchial wall occurs in these areas.

As stated before, the explanation of this is unknown, but it may have something to do with the lymphatic drainage in the bronchial wall itself.

Tuberculous tracheitis is rarely an isolated process. As a rule it represents extension of the bronchial lesion into the trachea and thus, in almost every instance, the tracheal lesion will be found on the side of and continuous with the bronchial involvement. The incidence of laryngeal tuberculosis in our cases has not been greater than that which would be anticipated in any group of tuberculous patients. Our experience here is in keeping with that of Samson.²²

CLASSIFICATION

Numerous classifications of tuberculous bronchitis have appeared in the literature and almost without exception they have been based on sound and careful study. As has been pointed out by Salkin, Cadden and Edson, there are so many classifications in the literature that it is difficult to compare the reported series.

In classifying any disease process the pathology and pathogenesis must be considered. With this in mind it is suggested that any classification of tuberculous bronchitis should consider the following points:

- 1) Type of bronchial lesion.
- 2) Location and extent of the process.

3) Is there an associated stenosis? If so, the degree and cause should be stated. The answer to these questions will bring forth most of the information needed to determine the actual condition of the bronchus and to decide its influence in the prognosis and treatment of any given case. Regardless of what classification is used, it seems absolutely essential that a good description should accompany every operative note. In our experience this has proved to be much more valuable than any actual classification of the lesion we have yet been able to find. At the present, the following classification and outline is used and it is very similar to many of those reported in the literature.

A Classification of lesion

- 1 Submucosal
- 2 Ulcerative
- 3 Hyperplastic type:
 - (a) With ulceration
 - (b) Without ulceration
 - (c) Tuberculoma
 - (d) Destruction of cartilage

- 4 Fibrous stenosis
 - (a) With ulceration
 - (b) Without ulceration
- 5 Eroding lymph gland
- B Location and extent of lesion
- C Associated Stenosis (yes, no)
 - 1 Degree of stenosis
 - 2 Cause of stenosis
 - (a) Inflammatory edema
 - (b) Hyperplastic changes
 - (c) Fibrostenosis

I should like to re-emphasize that the various types of bronchial lesions usually coexist. The ulcerohyperplastic type is the most common in patients who have been referred because of definite symptoms, signs, or x-ray findings. When bronchoscopy is done routinely a higher percentage of submucosal lesions will be encountered.

INDICATIONS

The indications for bronchoscopy in tuberculous patients are divided into clinical and roentgenological, and for the sake of clarity are enumerated under these headings. Only those considered to be most common and important are included.

A Clinical Indications:

- 1 Unilateral wheeze
- 2 Positive sputum without evidence of parenchymal source
- 3 Positive sputum with apparently controlled parenchymal disease
- 4 Severe symptoms (cough, difficulty in raising sputum, dyspnea and cyanosis) without evident cause in the parenchyma
- 5 Evidence of intermittent retention of secretions; such as, variation in the amount of sputum and the occurrence of fever
- 6 Prolonged fever following thoracoplasty

B Roentgenological Indications:

- 1 Mediastinal shift with or without elevation of diaphragm
- 2 "Hilar flare"
- 3 Opaque lesions of lobular, lobar, or multilobar distribution (Opaque lesion is used here in preference to the term "atelectasis"). These may appear suddenly following collapse therapy
- 4 Basal tuberculosis
- 5 Certain types of cavity
 - (a) Those with thin walls and fluid levels
 - (b) Those that fluctuate in size

- 6 Widespread parenchymal disease without evident parenchymal source
- 7 Obstructive emphysema.

As can be readily seen, the clinical and x-ray evidence of tuberculous bronchitis is based on the fact that in many of these cases there is narrowing of the bronchus with retention of secretion. A very high incidence of bronchial lesions will be discovered if the above signs and symptoms are used as a guide in selecting the patients. The incidence should be at least 50 per cent. The vast majority of cases referred for bronchoscopy who prove to have endobronchial lesions have more than one of the above signs or symptoms. The most common have been the unilateral wheeze, severity of symptoms, deviation of the mediastinum and elevation of the diaphragm, and the presence of opaque lesions or obstructive emphysema on x-ray. It must be realized that there is a stage in the development of tuberculous bronchitis that precedes the occurrence of these clinical and x-ray signs. Likewise, the bronchoscopist must realize that when the clinical and x-ray evidence is very definite, a negative bronchoscopy does not rule out severe involvement of the bronchial system just beyond his visual field, and re-examination is indicated.

CONTRAINDICATIONS

The following contraindications to bronchoscopy have been respected:

- 1) Terminal phase of disease
- 2) Pulmonary hemorrhage
- 3) Acute respiratory infection
- 4) Tuberculous laryngitis

The first three require no comment. Tuberculous laryngitis of the ulcerative type is considered an absolute contraindication except in case of extreme emergency, such as bronchial occlusion following thoracoplasty. If the laryngeal involvement is of the submucosal and inflammatory type, bronchoscopy is often performed if the patient is cooperative and trauma can be avoided.

TECHNIQUE

Technique is of more importance in bronchoscoping tuberculous patients than any other group referred for this procedure. This applies especially to anesthesia, which should be done very carefully and completely so that the entire bronchoscopic examination can be performed with the complete cooperation of the patient and without trauma. The patient is usually prepared with three

grains of sodium-pentobarbital and one-sixth grain of morphine. The use of scopolamine in tuberculous patients is discouraged because it prevents the patient from cooperating during the operative procedure. The posterior pharynx and the base of the tongue are first anesthetized by spraying lightly with a 10 per cent solution of cocaine-hydrochloride. After a few minutes the pyriform sinuses are sprayed; following this the larynx. The pyriform sinuses are then again cocainized with the use of the cross forceps. Following this the trachea and bronchi are anesthetized with 2 per cent cocaine. In performing this part of the anesthesia the laryngeal mirror is used to secure direct vision of the larynx and the cocaine is dripped between the cords. One cc. is placed into the trachea with the patient sitting upright. The patient is then leaned toward the side in which the lesion is not suspected and 1 cc. of cocaine is dripped into this bronchus. The patient is then leaned toward the involved side where most of the bronchoscopic work is anticipated and 2 cc. of cocaine injected into this side of the bronchial tree. As a rule, if sufficient time is taken to anesthetize the patient, a very small quantity of cocaine is required and anesthesia is usually complete. Occasionally it may be necessary to supplement the anesthesia during the bronchoscopy by spraying cocaine through the bronchoscope. The 7 mm. full-lumen bronchoscope is used and, as a rule, it is introduced without the aid of the laryngoscope. If there is any question about a laryngeal lesion and good visualization has not been secured with the mirror, the larynx is exposed with the laryngoscope. Bronchoscopy is proceeded with very slowly so that the bronchoscope will not be passed over an active lesion. If a tracheal or bronchial lesion is found the bronchoscope is kept proximal to it and treatment is applied with the scope in this position. Thirty per cent silver nitrate is applied directly to the granulation tissue or ulcerated areas. The tracheobronchial tree is aspirated as thoroughly as possible of all its secretion and the bronchoscope is withdrawn very slowly, aspirating all secretion which has collected around the scope. The rapid withdrawal of the bronchoscope in a tuberculous patient is to be condemned, especially in one who has had considerable secretion during the procedure. In these patients considerable secretion is always found in the trachea which has collected around the scope. If this is not removed, it predisposes to spread.

When the patient is returned to bed it must be remembered that his tracheobronchial tree has been completely anesthetized and his cough reflex abolished. During this time he must be protected against spread. This can be accomplished by placing the patient on his affected side for three hours. By this time the anesthesia will have worn off and his protective reflex will again be effective.

Using the above medication and technique, post-bronchoscopic reactions and spreads have almost been eliminated.

THERAPY

The local therapy of tuberculous bronchitis has been a most debatable point. Different authors have had such variable experience that there must be some explanation. For instance, Myerson states: "All of the active lesions in the tracheobronchial tree have the ability to heal in most patients. For this reason local therapy is frequently valueless and at times harmful." On the other hand numerous authors have reported excellent results from local therapy. Scharp and Gorham have reported 95 per cent good results, using 30 per cent silver nitrate; Tuttle, O'Brien, Day and Phillips, 70 per cent healing with silver nitrate; Packard and Davison, improvement in seven of eight cases, with the use of electrocautery; and a recent excellent article by Davies shows that of twenty-six patients treated with silver nitrate, seven were classified as arrested, sixteen improved, two unimproved, and one dead.

Salkin, Cadden and Edson state: "About three-fourths of all cases heal spontaneously if the disease in the parenchyma is controlled." Contrary to this, Alexander, Sommers and Ehler have found in their experience with sixty thoracoplasty patients with tuberculous endobronchitis, that: "Complete control of the parenchymal lesion by adequate collapse is not necessarily followed by anything like a corresponding improvement in the tracheobronchial lesion."

Why this vast difference in experience? Many factors may help to explain it.

1) *Type of Endobronchial Lesion:*

It is generally recognized that the early, submucosal type of tuberculous bronchitis has a much better prognosis than the ulcerohyperplastic and stenotic lesions regardless of therapy. Not only is the submucosal lesion the most benign of those seen in the bronchi, but as a rule it is associated with less extensive parenchymal tuberculosis, and is less apt to cause serious complications to collapse therapy. Once the ulcerohyperplastic or stenotic lesions have developed the prognosis becomes much worse, because it represents an open focus of disease, the pulmonary drainage tract is obstructed, and collapse therapy is rendered increasingly more dangerous. Thus it is evident that general statistics are of little significance. These cases must be broken down according to the type of lesion present in the bronchus. It is to be expected that a series of cases such as that of Salkin, Cadden and Edson with a high percentage (58.7%) of early, non-ulcerating lesions, will

present an entirely different picture from a group such as that published by Tuttle, O'Brien, Day and Phillips, in which 100 per cent of the cases had bronchial stenosis.

2) *Interval between Treatment:*

This may be a significant factor in explaining why some authors have had good results while others have failed in the local treatment of tuberculous bronchitis. The treatments must be sufficiently frequent to accomplish their purpose, which is twofold: (1) to stimulate the indolent tuberculous ulcer; and (2) to burn away granulation tissue so that the epithelium of the mucosa may close in over the ulcerating base. This also reduces that portion of the obstruction due to the presence of the granulation tissue. The experience of many workers has shown that a two or three week interval between treatments is the maximum if consistently good results are to be expected, when using silver nitrate as the cauterizing agent. If these bronchial lesions are treated irregularly, only when the bronchoscopist finds the time, or at infrequent intervals of two to three months, disappointing results are to be expected because this permits the granulation tissue to again build up to cause obstruction, stagnation of secretions, and increased inflammatory reaction.

3) *General Therapy of Patients:*

The general condition of the patient is a very important factor in the control of any tuberculous lesion. Tuberculous bronchitis is no exception. These patients should be at complete bed rest in a sanatorium, with the same diet and hygienic treatment offered a patient with an active parenchymal lesion. This is an extremely important feature, and one of the most neglected in the treatment of cases with bronchial tuberculosis.

4) *Duration of Bronchial Disease:*

As is true with any form of tuberculosis, early diagnosis and treatment offer the best chance of controlling the lesion. Good results cannot be expected if cases are referred for bronchoscopic treatment months, sometimes years, after signs and symptoms of endobronchial disease first appeared. All too often patients with bronchial tuberculosis are referred for bronchoscopy only after their general condition has become extremely poor and the parenchyma of the lung extensively involved. Not infrequently ill-advised collapse therapy has already been instituted and the expected complications (empyema, atelectasis, spread, anaerobic infection) have already occurred. Naturally institutions referring such patients for local therapy of bronchial lesions will have poor

results. Reports coming from such institutions must be analyzed carefully in evaluating these results. It is unreasonable to condemn any therapeutic measure in the treatment of any kind of tuberculosis when it is being applied, in the majority of instances, to far-advanced disease. We must come to look upon tuberculous bronchitis as we have the parenchymal lesion. The diagnosis must be made as soon as possible and therapy given immediately if the best results are to be anticipated.

5) *The Control of the Parenchymal Lesion:*

The control of the parenchymal lesion undoubtedly has a favorable influence upon the bronchial lesion in many instances. This is especially true if it is the source of a large amount of secretion which causes bronchial irritation. All bronchoscopists are familiar with the marked improvement in the bronchial lesion occasionally seen when a large cavity or a tuberculous empyema with a bronchopleural fistula has been drained. However, as has been pointed out before, control of the parenchymal lesion is not necessarily followed by corresponding improvement of the tuberculous bronchitis. Also, control of the parenchymal disease is not easily accomplished because of the presence of bronchial disease.

Thus, it is evident that many factors enter into the success or failure of the local treatment of tuberculous bronchitis. It also seems clear that treatment of the bronchial lesion is only one phase of the therapy of the tuberculous patient with this complication. It must be supplemented by rest and by the indicated procedure to control the associated parenchymal disease.

The following is a summary of the general concept we employ in treating these cases:

- 1) Local therapy with 30 per cent silver nitrate is used at intervals of two weeks. Treatment is instituted as early as possible. The rationale for this therapy has previously been stated. We have never seen stenosis result from the use of 30 per cent silver nitrate, and agree with many authors that any resultant fibrosis in the bronchus is the end result of the destruction of the bronchial structures by the tuberculous process itself. Usually the stenosis can be predicted when an extensive ulcerohyperplastic lesion is seen.

- 2) Local therapy is applied only to the areas of ulceration and granulation tissue. By removing the granulation tissue the patency of the bronchus is often increased.

- 3) No attempt is made to treat the fibrous stenoses. We know of no method which will effect any permanent dilatation of these lesions. Any associated ulceration or granulation tissue is cauterized. Dilatation and aspiration of retained secretions is at times

indicated for temporary relief of symptoms. Other than this, bronchoscopic treatment has no place in the treatment of these lesions. Supplemental treatment with complete thoracoplasty or pneumonectomy is advised.

4) Biopsy is never performed because of the danger of creating ulceration.

5) With lesions that are responding well, treatments are continued at two week intervals until all evidence of activity has disappeared. Following this the interval between treatments is gradually lengthened, but repeated examinations are performed for at least six months to determine any recurrence early. Following this, reinspection is advised at four to six month intervals unless symptoms of bronchial disease should recur. In this event bronchoscopy is immediately performed.

6) If improvement does not take place within a reasonable time, or if any of the complications are imminent, pulmonary resection is usually advised in our clinic. At times complete thoracoplasty is performed, with continuation of local therapy to the bronchial lesion. In all instances an attempt is made to apply therapy to the parenchymal lesion before any atelectasis, extensive spread, supuration, or anaerobic infection has taken place. It is the duty of the bronchoscopist to avoid procrastination in treating the bronchial lesion and to advise other therapy before any of the complications have occurred.

This outline of therapy has been followed with the realization that only a portion of the bronchial disease can be treated through the bronchoscope. In almost all cases the bronchial involvement extends to the parenchymal focus. However, we believe that by improving the condition of the major bronchi, better drainage of the small bronchi is effected.

Many authors question the value of local therapy of tuberculous bronchitis with silver nitrate or any other agent. Some maintain that it may cause actual harm and produce increased stenosis. As stated before, we have never seen 30 per cent silver nitrate cause stenosis. On the contrary, we have been convinced that it stimulates healing in the early active stages and, thus, prevents excessive tissue destruction and reduces the possibility of stenosis. In our experience it has given gratifying results in lesions which could be considered at all suitable for treatment. Davies has summarized the evidence in the literature, showing that cases treated locally had much better results than those which had no form of local therapy. His statistics show that, of those receiving treatments, 39 per cent were "arrested, healed or well, and 13 per cent dead;" of those who had no local therapy, only 11 per cent were classified as "arrested, healed or well, and 26 per cent dead." As

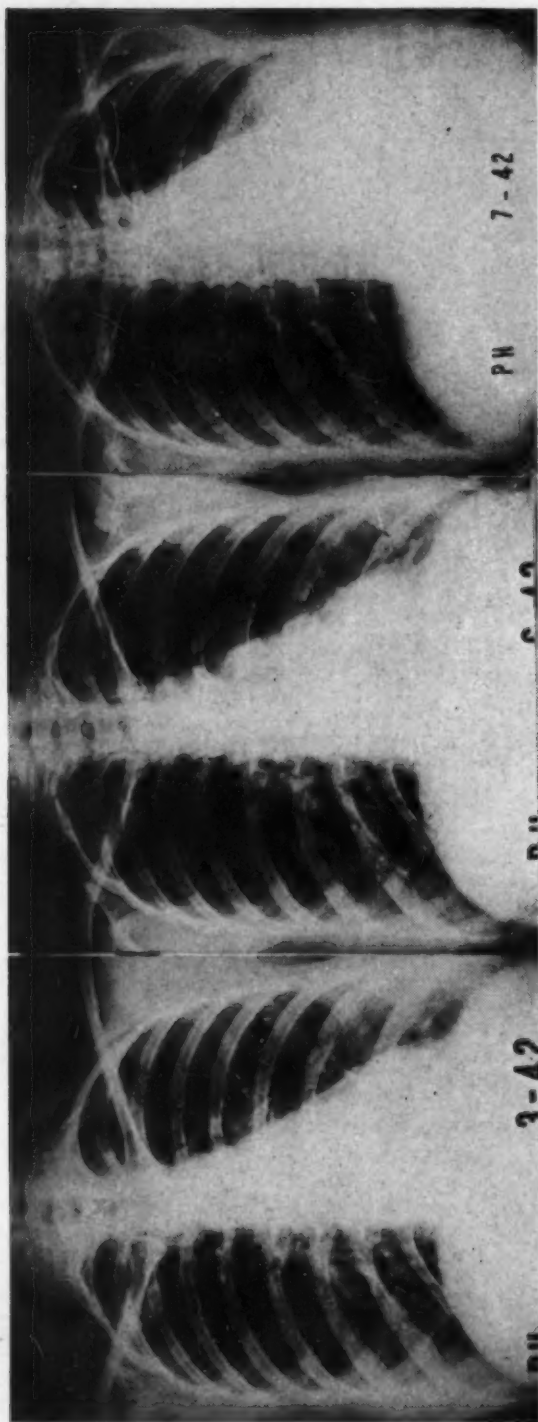


FIGURE 1a: MRS. P. H.

A 29 year old female. Duration of symptoms, three months. *Left:* Roentgenogram of chest in March 1942. Her chief complaints at this time were fatigue, low grade fever, and wheezing on left side of chest. Roentgenogram revealed minimal infiltration in left second interspace and some haziness at the left base. Note slight mediastinal shift to the left. *Middle:* Roentgenogram of June 1942 showing little if any change. *Right:* Roentgenogram of July 1942. Note the marked opacity that has developed suddenly at left base with increased shift of the mediastinum. This opacity was interpreted as atelectasis by the radiologist. Bronchoscopy at this time revealed an extensive ulcerostenosis of the left main bronchus just above the level of the upper lobe orifice. Pneumonectomy was performed within 8 weeks of the time the opacity developed.

he states, "there is less than one chance in two thousand that such a difference in results could be due to chance alone⁶."

It is hoped that this discussion has established a concept that the therapy of a patient with tuberculous bronchitis is very complicated and requires the complete cooperation of physician, surgeon and bronchoscopist to arrive at the most rational and effective program of treatment.



FIGURE 1b

This is the surgical specimen of the patient whose x-rays are shown in Figure 1a. The cut surface of the lung shows numerous caseous nodules. Numerous cuts through the lower lobe revealed the same appearance. The entire lower lobe was literally riddled with caseous nodules averaging 0.5 cm. in diameter. There was no cavity. The fundamental pathology here was not atelectasis but caseous tuberculosis. The opacity was caused by the superimposition of the numerous nodules in the lower lobe.

Comment: This case illustrates the densely opaque lung developing distal to an ulcerostenosis. Impaired drainage and the "backfiring mechanism" are suggested as the pathogenetic factors. These opacities pathologically are not atelectasis but extensive tuberculosis. In my opinion we should stop calling this type of x-ray shadow an atelectasis since the term gives us a false impression of what we are treating. This case is living and well today and has a consistently negative sputum.

PATHOLOGICAL PHYSIOLOGY AS SEEN THROUGH THE BRONCHOSCOPE

Two factors of extreme importance in determining the parenchymal pathology and the abnormal physiology of these cases can readily be seen through the bronchoscope. These are obstruction and stagnation of secretions. Even in the early lesion where no significant degree of stenosis is present, stagnation of secretions is quite evident by the tenacious secretions so often seen clinging to the walls of the bronchus. This is due to the loss of ciliary action and the decreased motion of the bronchial wall. Once stenosis has developed the role of mechanical obstruction comes into play. The stagnation of secretions is quite evident at this stage. At times that portion of the bronchus above the stenosis will be filled with purulent secretions up to the level of the carina and will have to be aspirated at the time of bronchoscopy in order to visualize the stenotic area at all. When the obstruction is only partial, more air can pass through the involved area on inspiration than on expiration due to the normal physiological dilatation of the bronchus during inspiration and contraction during expiration. This mechanism develops back pressure in the lung and is the cause of obstructive emphysema, tension cavities, and the failure of cavity closure with apparently adequate collapse. It also explains the occurrence of unexplained dyspnea and cyanosis because this blocked air has a low oxygen content and the circulating blood to this portion of the lung is returned to the general circulation poorly oxygenated. Partial obstruction may become more complete due to the presence of secretions, granulation tissue, or inflammatory edema. When this occurs atelectasis may develop beyond the obstruction.

We have been impressed in the study of resected lungs and in the review of serial x-rays by the occurrence, distal to the stenosis, of extensive nodular lesions, eventually being represented by a densely opaque segment of lung, and the frequent occurrence of small nodular spreads in the contralateral lung. The bronchoscopist can actually see the pathogenetic factor in the development of these lesions if he has the patient cough while the stenotic area is in view. The secretions from the distal portion of the bronchial tree will be seen hitting the stenosis and "backfiring" into the peripheral portions of the bronchial tree. However, an "atomizer" effect is evident on the proximal side of the stenosis where secretions are splattered into this portion of the tracheobronchial tree. Naturally, when the patient takes his next breath, the greatest draught of air enters his good lung and the aspiration of this finally dispersed droplet infection is undoubtedly the cause of

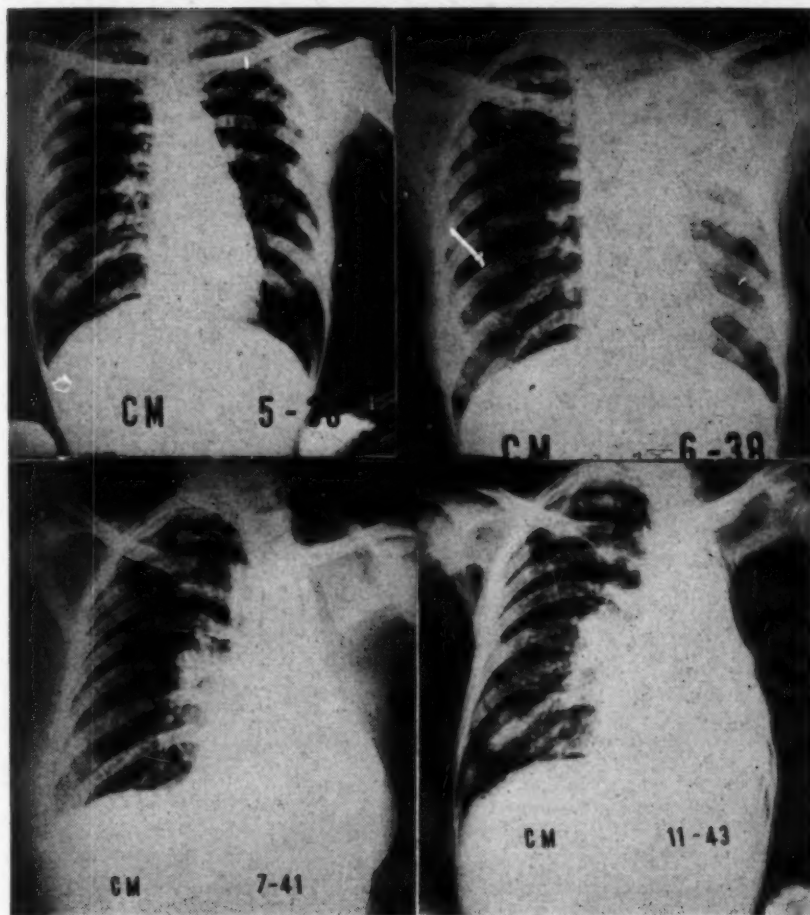


FIGURE 2: MISS C. M.

Age 41. Duration of illness, three years, eight months. *Upper left:* Roentgenogram of chest in May 1936 showing bilateral apical tuberculosis. *Upper right:* Roentgenogram of chest in June 1938 when the patient was admitted to the sanatorium for the second time. The lesion in the right apex has improved, but note the diffuse haziness involving the left upper lobe associated with mediastinal retraction. *Lower left:* Roentgenogram of chest two years following thoracoplasty showing the diffuse opacity of the entire left lung; very little change in the right lung. *Lower right:* Roentgenogram of chest of November 1943 at which time the patient was admitted to the sanatorium for the third time. Note the widely distributed fine nodular spread in the right lung. Also, the absence of any marked localized infiltration in any area of the right lung. The left lung has remained opaque.

Comment: This patient had been negative for eight months prior to the last readmission and had been clinically well for three years; when readmitted she was very sick. Bronchoscopy revealed a fibrous stenosis of the left main bronchus at its orifice. A large amount of pus was coming from the left lung through the stenosis. This case illustrates the development of the opaque lung behind the bronchial stenosis of the left main bronchus, and beautifully illustrates the "atomizer effect" in the contralateral lung. The "backfiring mechanism" is suggested as the cause of the diffuse involvement of the left lung and the "atomizer mechanism" as the cause of the diffuse nodular spread of the right lung.

the fine nodular lesions so frequently seen in the contralateral lung. We have chosen to call these the "backfiring" and the "atomizer" mechanisms. As time passes these become less evident because of the fact that as secretions become more purulent and profuse the entire bronchial tree behind the stenosis becomes literally filled with secretions and the parenchyma riddled with tuberculosis. These secretions tend to prevent the entrance of air and cause increased blockage to the many radicles of the bronchial tree. Anaerobic infection may become superimposed and cause the secretions to have a foul odor. At this stage the x-ray, almost without exception, will present a dense opacity involving the entire parenchyma beyond the point of occlusion in the bronchus. Retraction of the mediastinum and elevation of the diaphragm are frequently associated findings. These x-ray densities are commonly called atelectasis, but, except in rare instances early in their development or when the occlusion is temporary, they represent a parenchyma markedly involved with caseous tuberculosis, not merely airless lung tissue. For this reason the term opaque lung is applied to this type of x-ray shadow in preference to atelectasis. This conception explains the pathological finding that the most extensive parenchymal involvement is almost always distal to the bronchial obstruction, regardless of the original location of the disease. It also explains the high incidence of predominantly basal disease and extensive, scattered parenchymal lesions so frequently seen without cavitation as a source.

THE ROLE OF BRONCHOSCOPY IN DETERMINING THE TREATMENT OF THE PARENCHYMAL LESION

The experience and statistical studies of many authors have proved that collapse therapy may be not only ineffectual in the face of a bronchial lesion, but actually dangerous and may render the prognosis much more serious. It has also been shown that the type of tuberculous bronchitis present is of the utmost importance. The complications encountered in these patients during any collapse therapy program will be directly proportional to two factors: (1) the acuteness and extent of the bronchial involvement, and (2) the degree of stenosis present. The reason for this is that all collapse procedures cause relaxation and shortening of the bronchi and, as a result, are apt to increase the existing stenosis and further interfere with bronchial drainage. Pneumothorax is the greatest and thoracoplasty the least offender in this respect. A 50 per cent incidence of atelectasis has also been reported following phrenic paralysis in patients with stenotic lesions (25). Thus it seems to be quite evident that a careful evaluation of the bronchi should be a prerequisite to the institution of any collapse therapy. Many

clinicians and institutions now routinely bronchoscope all patients prior to thoracoplasty, and yet they fail to evaluate the condition of the bronchi prior to the more dangerous procedure of pneumothorax. It seems difficult to explain this inconsistency since the experience of so many has shown the disastrous result of pneumothorax in these cases.^{4,19,25} Ideally every patient who is to be a candidate for collapse therapy should be bronchoscoped. If this is impossible those with tuberculous bronchitis should be weeded out as much as possible by careful history, physical examination and x-ray studies. When the indications are present bronchoscopy should be performed. Such a program will discover most of the cases with obstructive bronchial lesions. Approximately 50 per cent positive bronchoscopic findings should result. This seems to be a more fruitful program than the routine bronchoscopic examination of only one portion of the collapse therapy patients, such as the pre-thoracoplasty patients, where only 10 to 15 per cent of the bronchoscopic examinations will reveal tuberculous bronchitis. It would seem obligatory to bronchoscope every patient in whom a bilateral collapse program is anticipated. This should be done regardless of the clinical evidence for or against the presence of bronchial disease.

The role of the bronchoscopist is to determine the type of bronchial disease present and, as far as possible, to evaluate its future course. If it is the type which will respond readily to local therapy and the airway is patent, bed rest or possibly pneumothorax may be indicated to control the parenchymal lesion. However, if stenosis is already present, complete thoracoplasty or resection should be advised before extensive parenchymal disease with superimposed anaerobic infection and the resultant poor condition of the patient develop. Pneumothorax and phrenic paralysis are contraindicated in such cases.

SUMMARY AND CONCLUSIONS

1) Tuberculous bronchitis is a frequent and serious complication of pulmonary tuberculosis. It occurs in 10 to 15 percent of all patients admitted to sanatoria.

2) The study of surgical pathology indicates that the earliest bronchial lesions are submucosal in type. The second stage is represented by hyperplastic changes and ulceration, and the third stage by healing. In the third stage a fibrous stenosis may result. The predilection for stenotic lesions to involve the left main bronchus and the right upper lobe bronchus has been suggested.

3) The indications for bronchoscopy in tuberculous patients have been outlined. If these are followed in selecting patients, about 50 percent of the bronchoscopies will reveal endobronchial disease.

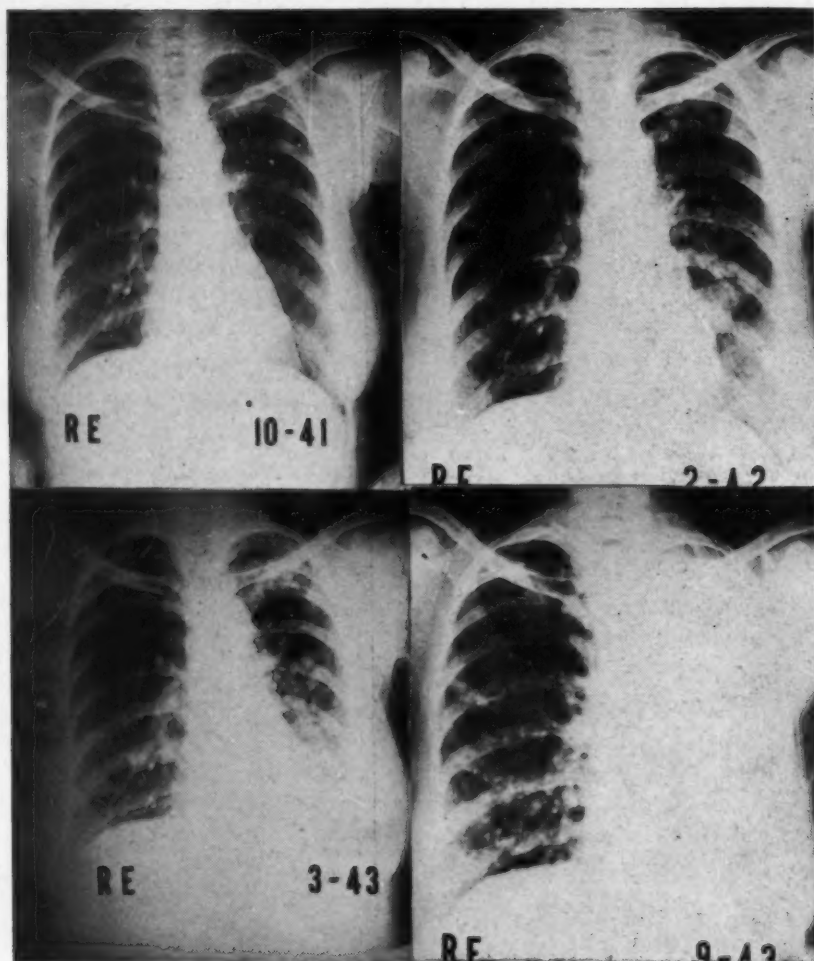


FIGURE 3: MRS. R. E.

Age 50. Duration of illness, eight years. *Upper left:* Roentgenogram of chest in October 1941 showing involvement in the left apex and scattered nodules throughout the remainder of the left lung. No definite cavity was visible to explain the source of this widespread disease. Patient was wheezing, and bronchoscopy revealed an ulcerostenosis of the left main bronchus. *Upper right:* Roentgenogram of February 1942 which shows very little change in the apical lesion on the left side but shows extension of disease at the base. A new area of infiltration is also seen at the level of the anterior third rib on the right side. Two months prior to this time extensive thoracoplasty or left pneumonectomy had been advised on this patient and refused. This advice was given because of anticipated spread which was bound to occur behind the stenosis. *Lower left:* Roentgenogram of March 1943 showing beginning retraction of the mediastinum and extensive spread of the tuberculosis in the left lung, especially at the base. Numerous fine nodules have begun to appear in the right lung, especially in the mid zone. *Lower right:* Roentgenogram of September 1943 showing the diffuse opacity of the left lung and extensive nodular spread throughout the right lung, especially at the base where many of the nodules are beginning to become confluent.

Comment: This case again illustrates the opaque lung developing behind

All patients presenting these indications should be bronchoscoped.

4) The existence of the preclinical phase of tuberculous bronchitis is emphasized. This can be diagnosed only by bronchoscopy performed routinely.

5) When clinical and x-ray evidence of tuberculous bronchitis is present, a negative bronchoscopy does not rule out involvement of the branch bronchi and repetition of the examination is indicated at a future date.

6) The importance of technique in performing bronchoscopy in tuberculous patients is emphasized. The following safeguards are indicated: (1) careful and complete anesthesia; (2) the avoidance of trauma to any bronchial lesions during the procedure; (3) the careful aspiration of all secretions in the tracheobronchial tree during the bronchoscopy and just before the bronchoscope is withdrawn. It is important to withdraw the bronchoscope slowly so that all tracheal secretions which have collected around the scope will be aspirated. (4) Place the patient on his affected side for three hours after returning him to his bed. This is done to protect him against spilling secretions to his good lung during a period when his cough reflexes have been abolished by the anesthesia.

7) The pathological physiology as seen through the bronchoscope is discussed and the importance of the bronchial lesion in determining the type of parenchymal lesion is presented. The stagnation and "backfiring" of secretions are described as the pathogenetic factors in producing the opaque lesions, basal tuberculosis, "hilar flares," and disseminated infiltration so commonly seen in the ipsilateral lung. An "atomizer" effect is described as the cause of the nodular spreads frequently seen in the contralateral lung.

8) Local therapy of the endobronchial lesion with 30 percent silver nitrate has been found to be effective in lesions considered to be suitable for treatment. These are the ulcerative and ulcerohyperplastic types. This represents only one phase of the treatment of these patients. Their general condition and the therapy of the parenchymal lesion are factors of extreme importance, neither of which should be neglected.

9) The presence of a marked fibrous stenosis contraindicates local therapy except for the cauterization of any associated ulceration or granulation tissue. Complete thoracoplasty or pneumonectomy is indicated in such cases. In my opinion, dilatation as a form of treatment does more harm than good and leads to

the stenosis and the fine nodular spread that occurs eventually in the contralateral lung. It also illustrates that complications of bronchial disease must be anticipated in the treatment of patients with this complication.

procrastination in applying surgery. It is indicated only to alleviate distressing symptoms, either as a temporary measure or in the hopeless case.

10) An evaluation of the bronchial system is as important as that of the parenchyma. Without it an intelligent approach to a therapeutic program is impossible. No patient with any of the symptoms, signs, or roentgenological evidence of tuberculous bronchitis should be given any type of collapse therapy without preliminary bronchoscopy.

11) The type of collapse therapy to be used in controlling the parenchymal lesion is governed by two factors: (1) the type of parenchymal disease; and (2) the type of endobronchial lesion present. The bronchoscopic findings should be considered prior to instituting collapse therapy, especially pneumothorax, in order to avoid serious complications.

12) In the light of present knowledge it would seem ideal to bronchoscope every patient on admission to the sanatorium. However, this seems to be impossible in most institutions and for this reason careful selection of patients by history, physical examination and review of x-ray findings is advised in preference to selecting any one group of patients, such as the pre-thoracoplasty patients, for examination.

13) The concept is presented that we are treating a patient with pulmonary tuberculosis with tuberculous bronchitis as a complication, not treating tuberculous endobronchial disease as an isolated pathological process. This demands consideration of the patient's general condition, the parenchymal disease, and the type of endobronchial lesion. It also requires the complete cooperation of the clinician, surgeon and bronchoscopist to arrive at the most effective program in the treatment of each individual case.

Resumen y Conclusiones

1) La bronquitis tuberculosa es una complicación frecuente y grave de la tuberculosis pulmonar, que sobreviene en del 10 al 15 por ciento de los pacientes admitidos en sanatorios.

2) El estudio de la patología quirúrgica indica que las lesiones bronquiales más tempranas son de tipo submucoso. El segundo período está representado por alteraciones hiperplásticas y ulceración; y el tercer período, por cicatrización. Puede resultar una estenosis fibrosa en el tercer período. Se ha sugerido que las lesiones estenosantes manifiestan predilección por el bronquio principal izquierdo y el bronquio del lóbulo superior derecho.

3) Se ha bosquejado las indicaciones para la broncoscopia en pacientes tuberculosos. Si se siguen estas indicaciones en la selección de pacientes, un 50 por ciento de las broncoscopias revelarán

lesiones endobronquiales. Todos los pacientes que presenten estas indicaciones deben ser broncoscopiados.

4) Se hace hincapié sobre la existencia de la fase preclínica de la bronquitis tuberculosa, la que sólo puede ser diagnosticada mediante la broncoscopia llevada a cabo sistemáticamente.

5) Cuando existen signos clínicos o radiológicos de bronquitis tuberculosa, una sola broncoscopia negativa no elimina la posibilidad de lesiones en las ramas bronquiales menores, y debe repetirse el examen en una fecha futura.

6) Se recalca la importancia de la técnica en la ejecución de la broncoscopia en pacientes tuberculosos. Se indican las precauciones siguientes: (1) Anestesia completa y cuidadosa. (2) Evitar el traumatismo de cualquiera lesión bronquial durante el procedimiento. (3) Aspirar cuidadosamente todas las secreciones en el árbol tráqueo-bronquial durante la broncoscopia e inmediatamente antes de sacar el broncoscopio. Es importante sacar el broncoscopio despacio para poder aspirar todas las secreciones en la tráquea que se han acumulado alrededor del instrumento. (4) Acostar al paciente sobre el lado enfermo por tres horas después de regresar a la cama. Se hace esto para evitar el derrame de secreciones a su pulmón sano durante el período en el cual los reflejos de la tos se hayan suprimidos por la anestesia.

7) Se discute la fisiología patológica que se observa a través del broncoscopio y se expone la importancia de la lesión bronquial en determinar el tipo de la lesión parenquimatosas. Se opina que el estancamiento y el flujo inverso de las secreciones son los factores patógenos en la producción de las lesiones opacas, la tuberculosis basal, las propagaciones hiliares y la infiltración diseminada que tan comúnmente se observan en el pulmón del mismo lado. Se describe un efecto de "pulverizador" que se opina que es la causa de las propagaciones nodulares que frecuentemente se observan en el pulmón del lado opuesto.

8) Se ha encontrado que el tratamiento local de la lesión endobronquial con 30 por ciento de nitrato de plata, es eficaz en lesiones que se consideran susceptibles para tratamiento. Estas son las de los tipos ulcerante y úlcero-hiperplástico. Este es sólo una fase del tratamiento de estos pacientes; su estado general y el tratamiento de la lesión del parénquima son factores de extrema importancia que no deben ser descuidados.

9) La presencia de una estenosis fibrosa marcada, contraindica la terapia local, con la excepción del cauterio de cualquiera ulceración o tejido de granulación concomitantes. En estos casos está indicada la toracoplastia total o la neumonectomía. En mi opinión, el empleo de la dilatación como tratamiento causa más daño que bien y conduce a la tardanza en la aplicación de la cirugía. La

dilatación está indicada solamente para el alivio de síntomas desesperantes, ya como medida provisional o en caso desahuciado.

10) Es tan importante avaluar el sistema bronquial como el del parénquima. Sin ello no se puede establecer inteligentemente una terapéutica adecuada. Ningún paciente que presente cualquiera de los síntomas o signos físicos o roentgenológicos de bronquitis tuberculosa debe recibir la colapsoterapia en ninguna forma sin una broncoscopia preliminar.

11) El tipo de colapsoterapia que debe emplearse para controlar la lesión parenquimatosa está gobernado por dos factores: (1) el tipo de la lesión parenquimatosa; y (2) el tipo de la lesión endobronquial existente. Se debe tener en cuenta las evidencias broncoscópicas antes de iniciar la colapsoterapia, especialmente el neumotórax, a fin de evitar complicaciones graves.

12) A la luz de lo que se sabe actualmente, parecería ser ideal el que se broncoscopiara a todo paciente a su ingreso al sanatorio. Empero, ésto parece ser imposible en la mayor parte de las instituciones, y por esta razón se recomienda la selección cuidadosa de los pacientes mediante la historia, el examen físico y la revista de los hallazgos radiológicos, en preferencia al seleccionar para el examen algún grupo de pacientes, tal como los que van a ser toracoplastizados.

13) Se presenta el concepto de que estamos tratando a un paciente con tuberculosis pulmonar que tiene bronquitis tuberculosa como complicación, y no tratando la lesión endobronquial tuberculosa como si fuera un proceso patológico aislado. Esto demanda el estudio del estado general del paciente, de la lesión parenquimatosa y del tipo de la lesión endobronquial, y también requiere la completa cooperación del clínico, el cirujano y el broncoscopista, a fin de establecer la terapéutica más eficaz en cada caso individual.

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Clinical Aspects of Endobronchial Tuberculosis*

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During the past two decades, many important advances have been made in the pathological, clinical, and roentgenological aspects of pulmonary tuberculosis. Although the literature is replete with many studies of this disease, the subject of endobronchial tuberculosis appears to have received scant attention. It was not until 1931, when Eloesser¹ called attention to the pathological changes and complications resulting from endobronchial tuberculosis, that it was recognized as a major problem. Then it was again neglected, and only in the past four or five years, has the entire problem of endobronchial disease with its far-reaching sequelae received the attention it deserves.

The reasons for this neglect are many. One can always blame the war and the resulting withdrawal of medical personnel from our sanatoria. The lack of well organized research departments in our sanatoria is appreciated by all who have been associated with state or county hospitals. The chief deficiency according to Lloyd and Buddetti² lies in the fact that in most places bronchoscopy remains fettered to the nose and throat department. I concur that the laryngologist usually has only a passing interest in the various manifestations of bronchial disease. Also many sanatoria are situated at a distance from medical centers, and the services of a trained bronchoscopist are either difficult to obtain or entirely out of reach. They are also correct when they state that the lung specialist can never consider himself adequately trained until he has mastered the art of bronchoscopy. Furthermore, bronchoscopy will never render its maximum service to medicine until it is embraced by the man to whom it rightfully belongs—the specialist in chest diseases. A new orientation as to who should bronchoscope the tuberculous patients is certainly desirable and should receive full discussion. May I also add that the unpleasant and frequently distressing reaction by the patient to inexperienced bronchoscopy has also probably been a deterrent factor in the frequency of this examination.

A thorough knowledge of the relationship of the underlying pathology of endobronchial tuberculosis to the altered dynamics of pulmonary function is a prerequisite to the intelligent understanding of the various clinical manifestations of this disease. Many

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students of lung pathology have directed our attention to the importance of bronchial occlusion as a major factor in pulmonary suppuration. Cutler and Schlueter³ have emphasized the interrelationship of endobronchial trauma to lung abscess, while Fleischner⁴ has repeatedly pointed to bronchial occlusion as the chief cause in the development of pulmonary disease. As with suppuration elsewhere in the body, successful healing depends upon adequate drainage. As long as bronchial drainage is interrupted or is inadequate, so long will the infection entrapped in the lobe continue to progress. A patent, physiologically adequate bronchus is essential for the normal function of lung tissue.

PATHOLOGICAL PHYSIOLOGY

Any interference with the normal flow of air to and from the lobe will produce static as well as dynamic changes in the lungs. Whether the pathological changes consist of diffuse edema or fibrous stenosis, the resultant decrease in the size of the lumen will greatly affect the passage of air. If the obstruction is nearly complete, the lobe will either shrink or become markedly distended. If the former occurs and infection is trapped, suppuration results. On the other hand, if a check-valve effect is present, localized emphysema develops. This may take place either in a whole lobe or part of a lobe. In cases where parenchymatous destruction or cavitation exists, variations in the size of the cavity will occur.

Clinically, this phenomenon is greatly exaggerated in the course of artificial pneumothorax therapy. In such cases, there is either a shrinkage of the involved lobe or lobes giving an opaque appearance to the lung or marked emphysema causing rapid loss of the pneumothorax space. The same holds true in thoracoplasty cases where cavities will not close in spite of the seemingly adequate collapse or where suppurative changes may ensue as a result of a blocked bronchus. It is thus quite evident that in order to insure good result in collapse therapy, be it pneumothorax or thoracoplasty, due consideration must be given to the presence or absence of endobronchial disease. To collapse a lung, even by artificial pneumothorax, without due regard for the integrity of the bronchial tree, is to invite many complications. The lung may fail to re-expand and the collapse may remain irreversible even after a short period of such treatment.

INCIDENCE

The incidence of endobronchial tuberculosis will obviously vary with the zeal as well as with the skill of the operator. Until routine endoscopic examinations are made on all sanatorium patients at periodic intervals, the true incidence of this complication will

not be definitely known. In most institutions, at the present time, patients are bronchoscoped only when there are suggestive signs and symptoms. At the Norfolk County Sanatorium in Massachusetts, 50 per cent of all patients bronchoscoped because of suspicious symptoms showed tuberculosis of the bronchi. So far, the best figures are those of Salkin, Cadden and Edson⁵ and their figure of 15 per cent must stand. The post-mortem figures of Auerbach, Silverman and others are naturally much higher, the incidence being as high as 70 or 80 per cent. A perusal of the literature places the incidence somewhere between 5 and 15 per cent.

CLINICAL FEATURES

The diagnosis of endobronchial tuberculosis can only be made definitely when it can be visualized by the bronchoscopist. Disease of the small bronchi may escape detection. In fact, only a small part of the larger bronchi come under the direct eye of the observer. Hence routine examinations of all sanatorium patients will fail to disclose peripheral lesions and thus mislead both the physician and the patient. Clinically, however, we are mainly concerned when the larger bronchi are stenosed. Obstruction of the peripheral bronchi results in atelectasis of small segments of lung tissue and may have no clinical significance.

The following study is based upon an analysis of 50 proven cases of tuberculous bronchitis. All of the patients were bronchoscoped by Dr. Richard H. Overholt or his associates. Although the number is small, I feel that 50 cases of proven bronchial disease is sufficiently large to throw some light on the various manifestations of this disorder. In this series, the predominance of females is noteworthy since they constituted 72 per cent (36) and the males only 28 per cent (14). The women were also of a slightly younger age, average being 36 years, while that of the males was 41 years.

The chief symptoms in this group were a *localized* wheeze or loud auscultatory rhonchi. These were present in 62 per cent of the cases. Indeed it was the localized wheeze that mainly aroused the suspicion as to the existence of this complication. In the case of two young women, no definite parenchymatous disease could be established roentgenologically. Because the wheezing was localized, endobronchial disease was anticipated. Subsequently, bronchoscopic as well as bacteriological examination confirmed our suspicion. While localized wheezing may be due to any bronchial obstruction, such as mucous plugs, distortion of the bronchi by scars or outside enlarged mediastinal glands or tumors, I feel that the burden of proof in all cases of localized wheezing occurring in the course of pulmonary tuberculosis is that it is not tuberculous in nature. The admonition that everything that wheezes is not

necessarily asthma certainly holds good in pulmonary tuberculosis.

Next to wheezing and rhonchi, our attention to this disease in the cases of artificial pneumothorax was directed by the so-called completely 100 per cent collapsed lung or the "opaque" unexpandable lung. I refer to it as "opaque" lung rather than atelectatic as infection may dominate the picture in these lungs rather than mere lack of aeration. Twenty patients of this group fell into this category. Nine of these patients had a complete collapse, as no lung could be visualized. Attempted re-expansion resulted in mediastinal distortion with marked displacement of heart and mediastinum. While the wheezing disappeared when the lung was completely collapsed, any attempt to re-expand the lung caused a return of this symptom. Pneumothorax therapy in the case of one young man caused marked ballooning of the cavity to giant proportions. Variations in the size of the cavity with the increase or decrease of intrapleural pressure was noted in two cases. Pneumothorax therapy in one patient brought out the evidence of cavitation which was not clear prior to this treatment. The same thing holds true in cases of thoracoplasty, where failure to close cavities or convert sputum, persistence of cough, copious expectoration, hemoptysis as well as evidence of pulmonary sepsis is due to endobronchial disease.

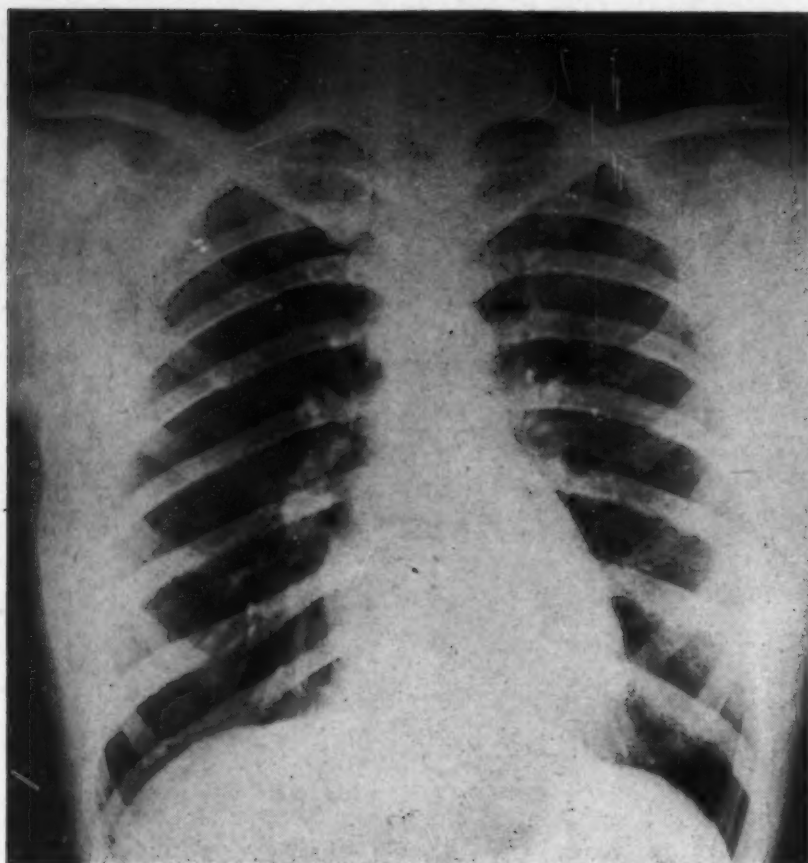
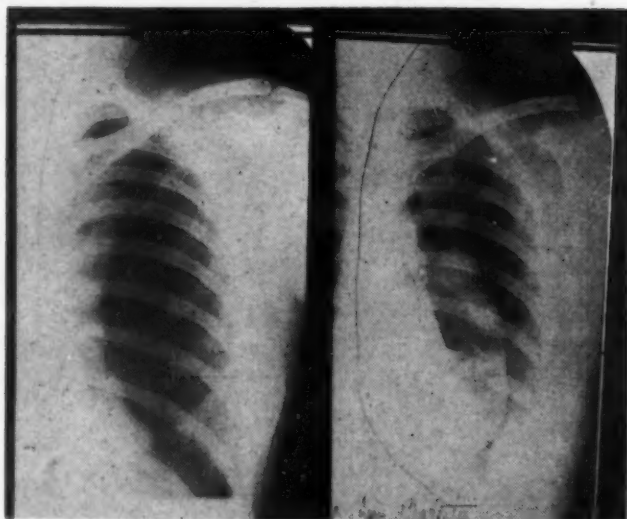
An interesting symptom in endobronchial tuberculosis is pain, or sometimes mild soreness, in the sternal region. This was encountered in 15 patients. The pain was not severe. Usually, it was described by the patients as an annoying itch or smothering sensation in the lower sternal region. This symptom is probably due to infection of the mucosa of the larger bronchi and occurs in the early stages of this disease rather than in the advanced later stages.

Symptoms resembling tuberculous bronchiectasis were encountered in 6 patients. All six had collapse therapy; two had artificial pneumothorax and four had thoracoplasty. The course of the disease followed the typical pattern of bronchiectasis; namely, frequent hemoptysis, or blood-tinged sputum, bouts of fever, intermittent cough and expectoration of large amounts of sputum. For the most part, their mode of life was that of a semi-invalid. Rest treatment had little or no influence on the course of the disease.

Anaerobic infection with abscess formation is a very serious complication. It occurred in two cases following complete stenosis of the bronchi.

CASE HISTORIES

Case I—Miss M. B., age 29, was first examined in 1938 as a contact case. She gave a history of having frequent colds, however, in the past two years, which caused her to wheeze. X-ray examination (Fig. 1) showed no definite abnormalities in the lung fields. Physical exam-

*Figure 1**Figure 2**Figure 3*

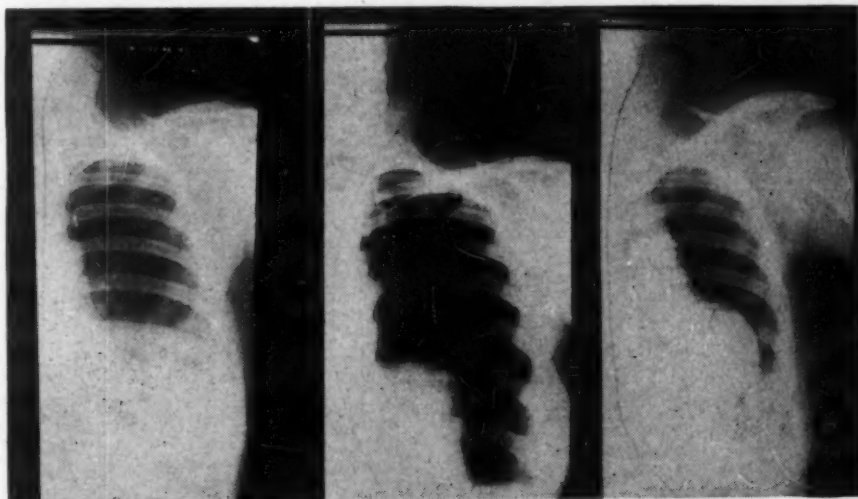
ination did reveal many dry palpable sonorous rales as well as occasional subcrepitant rales at the left base. The wheezing persisted and the cough gradually increased in severity. She was treated in the allergy clinic for six months with very little relief. Search was then made for tubercle bacilli and a high Gaffky count was found. Roentgenographic examination at this time revealed an area of mottling around the left hilum with a flare toward the periphery.

Pneumothorax therapy was instituted on the left side resulting in complete collapse of the lung (Fig. 2). The wheezing subsided and for a time, the patient made rapid improvement. The left lung, however, remained opaque and she developed a small pleural effusion. After two years of pneumothorax therapy, she began to have attacks of fever, distressing cough and the sputum again became positive. Bronchoscopic examination disclosed marked narrowing of the left main orifice. In spite of lengthening the intervals between refills, the lung showed little or no tendency for re-expansion (Fig. 3). The patient continued to run a down-hill course with low-grade fever. Bronchoscopic treatment was deemed inadvisable because of the stenosis which was already present. Resection of the left lung was therefore carried out two years ago, with apparently good results.

This case demonstrates early bronchial disease with no apparent parenchymatous involvement. The infiltration around the hilum rather than at the periphery is also quite suggestive of early endobronchial tuberculosis.

Case II—Miss J. Y., age 37, was first seen in September, 1940, because of a persistent cough which lasted for many months. Physical examination revealed many moist rales at the left base with evidence of cavitation at the same area. X-ray film (Fig. 4) showed a cavity at the left base with a surrounding area of atelectasis. Sputum was found to be positive.

Pneumothorax therapy in this case resulted in complete collapse of the left lung with an opaque shadow at the base (Fig. 5). Bronchoscopy

*Figure 4**Figure 5**Figure 6*

showed granulation tissue, about 2 cm. below the carina, of the left main bronchus, just above the orifice of the left upper lobe. There was also stenosis of the left main stem bronchus leaving a lumen not over 2-3 mm. in diameter. Re-expansion of the lung was found to be impossible (Fig. 6). In spite of being in bed, she continued to have frequent attacks of fever as well as an annoying wheeze. Because of the marked narrowing of the lumen of the main bronchus, pneumonectomy was carried out in September, 1942. Since then, she has been asymptomatic.

In this case, the left basal involvement is suggestive of bronchial disease. The patient also had early atelectasis at the left base. The opaque lung following pneumothorax therapy is quite characteristic.

Case III—Mrs. S. B., age 42, was first seen in 1940 after she spent three years in a tuberculosis hospital as a very sick patient. She coughed and raised considerable sputum which showed a high Gaffky count.

Pneumothorax therapy was attempted but no free pleural space was found. Phrenicotomy on the right side had very little effect on the disease (Fig. 1). A two-stage thoracoplasty failed to close the cavity or convert the sputum. In fact, the cavity appeared to be under tension with some ballooning (Fig. 8). Bronchoscopic examination revealed active disease at the right upper lobe bronchus with many small areas of ulceration. Bronchoscopic therapy with 30 per cent silver nitrate apparently controlled the ulcerative lesion and further surgical revision is now contemplated.

If bronchoscopic therapy were carried out in this case prior to her thoracoplasty, sputum might have been converted and closure of the cavity might have been accomplished. However, four years ago, bronchoscopy prior to thoracoplasty was not routinely employed.

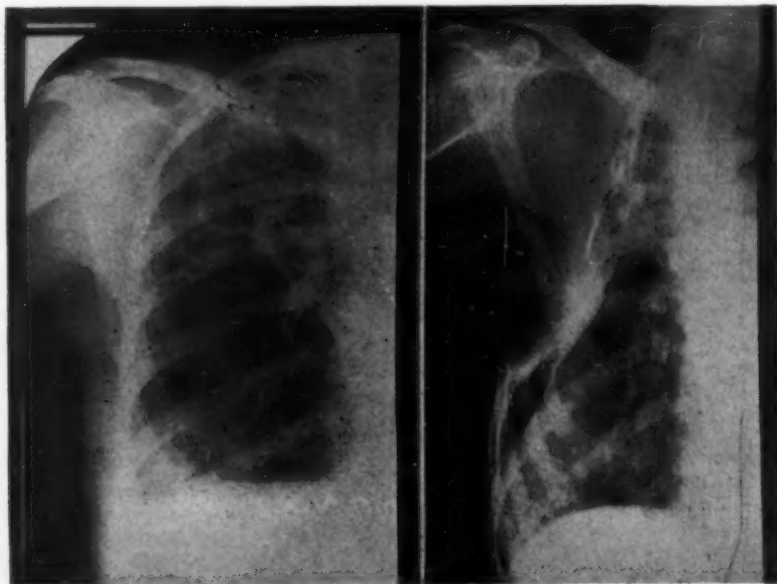


Figure 7

Figure 8

Case IV—Miss C. S., age 36, was first seen in consultation in 1938. Patient was apparently well until about 6 weeks ago when she contracted a cold and began to cough and raise. At times, she also noticed that she was wheezing. Sputum was found to be positive and x-ray examination disclosed an early lesion at the left upper lobe.

Pneumothorax therapy was immediately carried out, but to our surprise, a large ballooned-out cavity appeared (Fig. 9). Internal closed pneumolysis had no effect on the cavity, and accordingly, an open pneumolysis was done. Cavity however, remained open for about three months (Fig. 10). Subsequently, pneumothorax therapy was discontinued. The patient thereafter began to go down-hill. X-ray examination showed atelectasis of the left lung with evidence of abscess formation (Fig. 11). One month later, the abscess became putrid and patient began to raise large amounts of foul sputum (Fig. 12). Open drainage of the abscessed cavity was attempted but patient died suddenly, apparently of an internal hemorrhage.

Pneumothorax therapy in this case was distinctly harmful because it interfered with pulmonary drainage and created a good medium for anaerobic infection. Bronchoscopic treatment prior to pneumothorax or resection of the lung should have been carried out.

Case V—Miss M. E., age 18, was first seen in 1935. Patient's history was that of cough and wheeze for about one year. X-ray examination disclosed soft mottling at the left base with atelectasis in the region of the left hilum (Fig. 13). Sputum was positive.

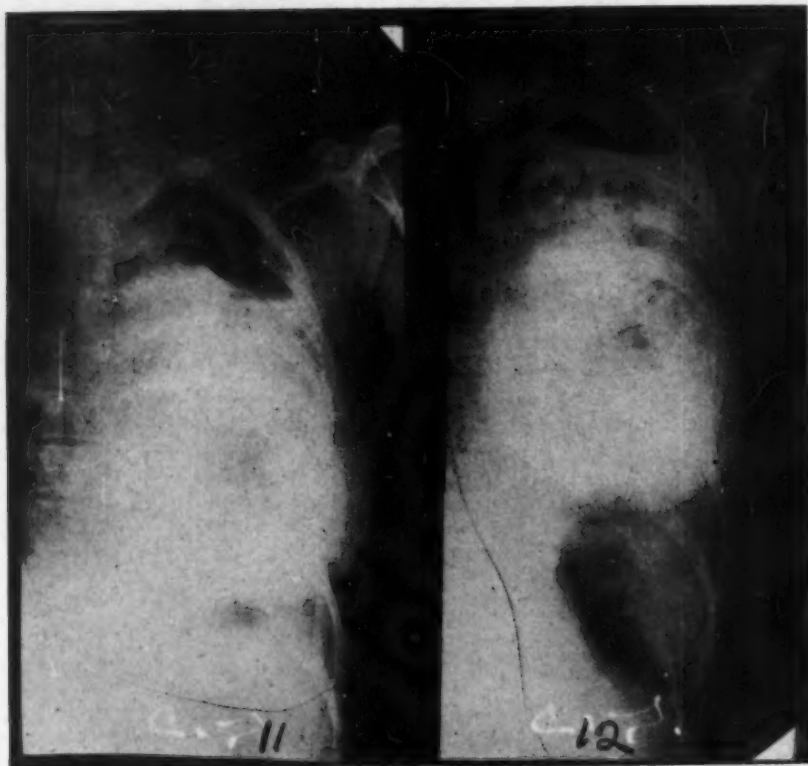
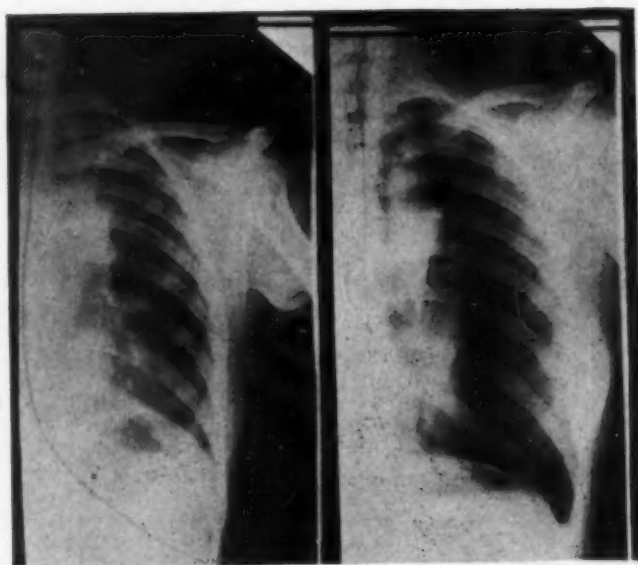
Pneumothorax therapy was initiated on the left side with complete collapse of almost the entire lung plus an opaque area in the upper portion near the hilum (Fig. 14). Soon, however, the upper lobe became emphysematous and was collapsed with great difficulty (Fig. 15). Wheezing continued and patient showed signs of dyspnea. Because of the difficulty of collapsing the upper lobe, pneumothorax therapy was dis-



Figure 9



Figure 10

*Figure 11**Figure 12**Figure 13**Figure 14*

continued and the left lung apparently re-expanded rapidly (Fig. 16). Bronchoscopy was not done during this period since all her symptoms were ascribed to allergic asthma. Not until she came down with a severe attack of grippe about one year later, was bronchoscopy carried out. The lumen of the left main bronchus was almost completely stenosed. The patient developed suppuration of the entire left lung and died of general sepsis.

In this case, the wheezing and the emphysema of the upper lobe should have been indications for earlier bronchoscopy.

DISCUSSION

It is not within the scope of this paper to discuss the clinical course or the therapy instituted in all of these cases. That the treatment of endobronchial tuberculosis is still unsatisfactory is quite evident. Whether topical applications with silver nitrate, x-ray therapy, conservative treatment or early radical resection is the treatment of choice awaits the experience of many more years of observation. The diagnosis as well as the treatment of tuberculosis requires meticulous care and the mutual co-operation of the various specialities. Only with close scrutiny, utilizing all the methods at our command, can we ever hope to have a definite insight and intelligent understanding of so protean a disease as tuberculosis.

SUMMARY

1) Endobronchial disease is not an uncommon finding in pulmonary tuberculosis. It probably occurs in 5-15 percent of all tuberculous patients.

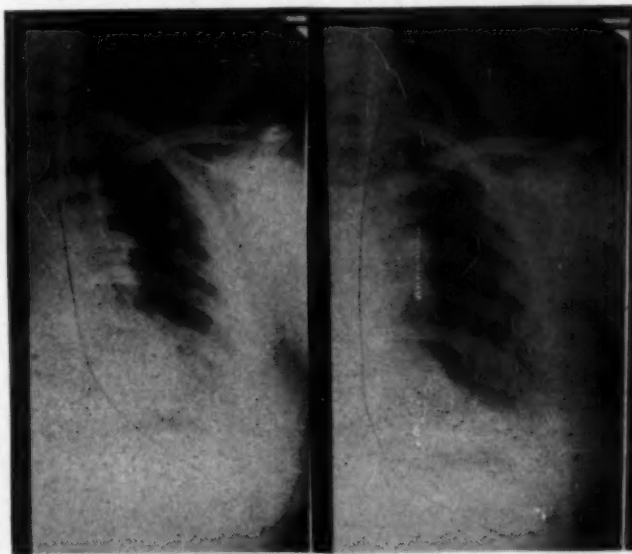


Figure 15

Figure 16

2) Bronchial obstruction as a result of bronchial disease alters the clinical course as well as the prognosis of pulmonary tuberculosis.

3) The signs and symptoms are essentially those of partial atelectasis with resultant superimposed infection.

4) Localized wheeze or loud rhonchi are the most important physical signs but are not pathognomonic.

5) Roentgenologically, areas of atelectasis, especially at the left base or the opaque lung following pneumothorax therapy, are strongly suggestive of this complication.

6) Bronchoscopy, when clear visualization is possible, is our only means of establishing a definite diagnosis.

7) Wider use of the bronchoscope in all suspicious cases of endobronchial tuberculosis is recommended.

Discusión

No cabe dentro de los límites de este trabajo el discutir ni la evolución clínica ni la terapéutica aplicada en todos estos casos. Es evidente que el tratamiento de la tuberculosis endobronquial todavía no es satisfactorio. La experiencia de muchos años más de observación demostrará si el tratamiento de elección es el de la aplicación local del nitrato de plata, la radioterapia, el tratamiento conservador o la resección radical temprana. El diagnóstico y el tratamiento de la tuberculosis requieren cuidado escrupuloso y la cooperación mútua de las varias especialidades. Solamente con el escudriñamiento íntimo, utilizando todos los métodos a nuestra disposición, podremos esperar adquirir una idea bien definida y una comprensión bien fundada de una enfermedad tan variable como la tuberculosis.

Resumen

1) Lesiones endobronquiales no son hallazgos raros en la tuberculosis pulmonar, pues sobrevienen probablemente en del 5 al 15 por ciento de pacientes tuberculosos.

2) Obstrucción bronquial, causada por lesiones bronquiales, altera la evolución clínica y el pronóstico de la tuberculosis pulmonar.

3) Los signos y síntomas son, en lo esencial, los de atelectasia parcial con la infección superpuesta resultante.

4) Estertores sibilantes o fuertes estertores roncantes, localizados, son los signos físicos más importantes, pero no son patognomónicos.

5) Desde el punto de vista roentgenológico, áreas de atelectasia, especialmente en la base izquierda, o el pulmón opaco subsecuente al neumotórax artificial, son signos que sugieren la presencia de esta complicación.

6) La broncoscopia, cuando es posible la visualización clara, es el único medio de establecer el diagnóstico bien definido.

7) Se recomienda el uso más extenso del broncoscopio en todo caso sospechoso de tuberculosis endobronquial.

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Pulmonary Resection for Tuberculosis Complicated by Tuberculous Bronchitis (Preliminary Report) **

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Two very significant advances have been made in the field of tuberculosis in the past decade. In the first place, most of our knowledge concerning tuberculous tracheobronchitis has been developed during this period. Secondly, lobectomy and pneumonectomy for pulmonary tuberculosis have become procedures with such a margin of safety that they should be considered in any therapeutic program in handling such cases.

Tuberculous tracheobronchitis has been established as one of the most common and most serious complications of pulmonary tuberculosis. The frequent occurrence of this complication has been demonstrated by the reported 40 per cent incidence in autopsy series^{2,9} and also by a 10 to 15 per cent incidence on routine bronchoscopic examination of patients upon admission to sanatoria.^{6,9} The serious prognosis and the complex therapeutic problem presented by tuberculous tracheobronchitis has been emphasized many times in the literature. Treatment is especially difficult, for one must contend with two large factors: (1) the type, location and extent of the parenchymal lesion, and (2) the type, extent and severity of the bronchial lesion itself. During the past few years, numerous clinical studies have revealed not only the limitations, but also the actual danger of many collapse procedures in such cases. These studies have established the fact that the more extensive the bronchial involvement, the less likely is any collapse procedure to succeed. It has also been shown that apparent complete control of the parenchymal lesion is not necessarily followed by a corresponding improvement in the bronchial lesion itself.¹ Most authors agree that pneumothorax and phrenic paralysis are contraindicated in the face of extensive bronchial ulceration or marked stenosis because of the high incidence of atelectasis, unexpandable lung, empyema and anaerobic infection. Complete thoracoplasty has given by far the best results in any of the larger series reported. Analysis of the reported series, however, suggests that thoracoplasty has been applied to only a fraction of patients with tracheobronchial involvement. Many cases with complicating tuberculous

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bronchitis progress rapidly and probably never are considered suitable for thoracoplasty. Only those patients who weather the storm and gradually settle into a more or less stabilized form of disease live to be acceptable for thoracoplasty. The incidence of tension cavities, basal disease and widespread active disease is high in patients with bronchial involvement and associated stenosis. They notably do poorly with thoracoplasty. Even in those cases which would appear to be suitable for thoracoplasty, the operative procedure, although done in carefully graded stages, has not been without danger. The postoperative course has tended to be very stormy and the incidence of spread and late exacerbation in the parenchyma distal to the involved bronchus has been high.

Because of an actual or predicted failure with collapse procedures, pulmonary resection has been carried out in an increasing number of patients with this complicated form of tuberculosis. The present report deals with 30 patients treated by one of us (R. H. O.) Resections were performed between 1934 and January 1, 1944.* Pre-operatively these patients fell into two classifications as to risk involved: desperate or last resort (12 patients) and reasonable (18 patients). Many of the desperate risks had active disease which

*During this period of time a total of 78 resections had been performed for pulmonary tuberculosis. The incidence of bronchial disease as diagnosed by bronchoscopy in this entire group was 38.4 per cent.

TABLE I
GENERAL STATISTICS

I. Total number of patients	30	B. 6 months to 1 year	8
II. Total number of operations	30	C. 1 year to 2 years	2
A. Pneumonectomies	27	D. 2 years to 3 years	3
1. Right	10	E. 3 years to 4 years	4
2. Left	17	F. 4 years to 5 years	5
B. Lobectomies	3	G. 5 years to 6 years	2
1. Left lower	1	H. 6 years to 7 years	1
2. Rt. middle and lower	1	I. 7 years to 8 years	0
3. Lt. lower and lingula	1	J. 8 years to 9 years	0
III. Age of patients—21 to 57 years		K. 9 years to 10 years	0
A. 20 to 30 years	6	L. 10 years to 15 years	4
B. 30 to 40 years	18	VI. Type of endobronchial tuberculosis	
C. 40 to 50 years	3	A. Submucosal	1
D. 50 to 57 years	3	B. Ulceration	5
IV. Sex		C. Ulcerostenosis	11
A. Male	6	D. Fibrous stenosis	13
B. Female	24	VII. Incidence of positive sputum	
V. Duration of disease—7 weeks to 19 years		at time of resection	
A. Under 6 months	1	A. 29 of 30 patients	96.6%

was rapidly progressive. Others had been subjected to collapse procedures with failure to control the disease. In the opinion of those who were taking care of these desperate risk patients, they possessed a fatal type of tuberculosis, and resection offered them their only chance. Any salvage in this group could be considered as pure gain.

In Table I general data concerning these patients is given. Attention should be called to several significant facts: (1) 96.6 per cent of the patients had a positive sputum at the time of resection; (2) the sex ratio was 4 to 1 in favor of females, which is in keeping with most of the reported series on endobronchial disease; (3) the majority of patients were in the fourth decade of life; and (4) 24 of the 30 had stenotic bronchial lesions, 11 with associated ulceration. Five had ulcerative lesions. Only one had a submucosal type of tuberculous bronchitis and this was associated with marked edema which caused 50 to 60 per cent narrowing of the right upper lobe orifice. The distribution of the bronchial lesions was as follows:

Left lower lobe bronchus	3
Left upper lobe bronchus	2
Left main bronchus	13
Right main bronchus	3
Right upper lobe bronchus	4
Right middle and right upper lobe bronchi	1
Right intermediate and right upper lobe bronchi	1
Right intermediate bronchus	3

INDICATIONS

Table II presents the indications for resection in this series. There were four cases of associated suppurative disease. This was one of the most common indications for resection in pulmonary tuberculosis, with or without bronchial disease, several years ago. All four of these cases were operated on prior to 1939. Five cases had previously had thoracoplasty with failure to control the disease.

TABLE II
INDICATIONS FOR RESECTION
(30 cases)

I. Associated suppurative disease	4
A. Controlled tuberculosis with bronchiectasis in other lobes	1
B. Active tuberculosis with bronchiectasis in other lobes	2
C. Extensive bronchiectasis, abscesses, and tuberculosis	1
II. Post-thoracoplasty uncontrolled disease	5
III. Extensive, multilobar, predominantly unilateral tuberculosis	21

In 21 patients the indication for resection was the presence of extensive multilobar tuberculosis which was predominantly unilateral. Many of these cases were considered by their medical staffs to have a fatal type of disease in the lung which was to be resected.

COMPLICATIONS

Table III presents the complications encountered in this entire series. The statistics have been broken down into two groups: (1) cases operated on prior to January, 1942; and (2) those operated on since January, 1942. The reason for this division is the fact that surgical technique prior to this date was variable. In these early cases the pleural flap method of bronchial closure was not routinely used and the tourniquet method was employed in a few instances. Since January, 1942, the pre- and postoperative care and the operative technique have been fairly well standardized. This group seems to represent what pulmonary resection has to offer patients with bronchial disease today. As Table III indicates, 19 resections were performed between January, 1942, and January, 1944, all of which were pneumonectomies. It is noteworthy that there were no

TABLE III
COMPLICATIONS

I. Complications related to tuberculous infections				
	Prior to January, 1942 11 cases		January, 1942, to January, 1944—19 cases	
Wound infections	0	0	0	0
Temporary fistula	1	9.1%	0	0
Permanent fistula	2	18.2%	1	5.2%
Empyema	4	36.4%	2	10.5%
A. With fistula	3	27.3%	1 (mixed)	5.2%
B. Without fistula	1	9.1%	1 (staph.)	5.2%
Contralateral spread (P. O.)	1	9.1%	3	15.8%
Stump ulcer	?	?	4	21.0%
Post-operative contralateral exacerbation	0	0	2	10.5%
Late contralateral exacerbation	0	0	1	5.2%
Contralateral pleurisy with effusion	1	9.1%	1	5.2%
II. Complications related to surgical problem of pulmonary resection				
A. Pulmonary insufficiency				2
B. Embolism				1
C. Circulatory failure				1
D. Post-operative shock				1

wound infections in any of these cases and that with the modern technique of closing the bronchus there was only one fistula following January, 1942. This occurred nine months following resection in a patient who had not only an active bronchial lesion but also a positive pleural fluid prior to operation. Only two empyemas were encountered in this last series, one a mixed empyema associated with the fistula in the patient mentioned above, and one caused by staphylococcus aureus. The biopsy of the pleura in this latter case at the time the empyema was drained and the studies of the fluid failed to reveal any evidence of tuberculosis. This fact was of considerable interest inasmuch as this patient was known to have had clear pleural fluid which was positive for tubercle bacilli for at least two years prior to resection.

Contralateral spread during the postoperative period occurred in three of the cases in the latter series—an incidence of 15.8 per cent. This complication is still too common and represents one of the biggest problems to be solved in the field of resection for pulmonary tuberculosis. Contralateral pleurisy with effusion has developed in two instances. In one of these the fluid was negative by guinea pig inoculation, and in the other it was positive. In neither case has a parenchymal lesion developed in the underlying lung and both patients are at home and are clinically well at the present time. Two cases in this latter group developed contralateral exacerbation in the postoperative period, and one case developed a late exacerbation eight months after operation adjacent to an area previously involved.

Routine postoperative bronchoscopic examination revealed ulceration in the bronchial stump in 4 patients, an incidence of 21 per cent. This complication has not been mentioned statistically in other reports on resection. It is interesting that two of these patients had negative sputum repeatedly on all bacteriological methods except by guinea pig inoculation, and yet the secretions aspirated at the time of bronchoscopy were positive on direct smear. One of the other patients was positive on routine sputum examination and the fourth one was positive only on gastric washing. These patients had no symptoms which would lead one to suspect such a complication. Bronchoscopy is, of course, the only way to make the diagnosis. The lesions were treated with 30 per cent silver nitrate at two-week intervals. Three of them have cleared and secretions aspirated at the time of bronchoscopy are now negative on smear and concentration. Two are negative and one is positive on guinea pig inoculation. The fourth patient has not returned for regular treatment. In spite of the ulceration of the mucosa in these cases there has been no tendency for the bronchial closure to break down and fistulae have not developed.

MORTALITY

Mortality figures are shown in Tables IV and V. For the entire group the total operative mortality was 26.6 per cent. It should be emphasized, however, that all but one of these deaths occurred in those who were accepted as last resort or desperate risks. The operative mortality in reasonable risk cases was 5.5 per cent. There were three late deaths in this entire group and all of these were patients treated prior to 1942. One was among the reasonable risk cases and two were in the desperate risk group, changing the case mortality to 36.6 per cent. Since January, 1942, one of the twelve reasonable risk cases has died in the postoperative period. The cause of death was embolism. There have been no late deaths in this second group.

Tables VI and VII analyze the postoperative and late deaths. These tables show that most of the postoperative and late deaths have occurred in patients who were classified preoperatively as desperate risks. In fact, in the entire group only one of the eight patients who died in the postoperative period had been classified

TABLE IV
MORTALITY STATISTICS—ENTIRE SERIES
1934 to January 1, 1944
(30 resections)

I. Operative mortality	
Total	26.6% (8 of 30)
A. Reasonable risks	5.5% (1 of 18)
B. Desperate risks	58.3% (7 of 12)
II. Total case mortality	
Total	36.6% (11 of 30)
A. Reasonable risks	11.1% (2 of 18)
B. Desperate risks	75.0% (9 of 12)

TABLE V
MORTALITY STATISTICS
Resections between January, 1942, and January 1, 1944
(19 cases)

I. Operative Mortality	
Total	26.3% (5 of 19)
A. Reasonable risk cases	8.5% (1 of 12)
B. Desperate risk cases	57.1% (4 of 7)
II. Total Case Mortality	
(Identical with operative mortality in this group as there have been no late deaths.)	

TABLE VI
ANALYSIS OF POST-OPERATIVE DEATHS

Name	Age	Date of operation	Pre-op. classification Desp. risk	Reas. risk	Operation	Duration of illness	P.O. day of death	Cause of Death
Miss L. M.	57	2/6/41		Yes	Rt. M. & L. lobectomy	2 yrs.	32nd	Empyema, C.N.S. symptoms
Miss B. L.	33	9/26/41		Yes	L. pneumo-nectomy	10 yrs.	4th	Contralateral tuberculous, pneumonia
Miss V. N.	30	12/30/41		Yes	Rt. pneumo-nectomy	3 yrs.	4th	Pulmonary insufficiency
Mr. J. C.	54	3/29/43		Yes	Lt. pneumo-nectomy	4 yrs.	53rd	Contralateral exacerbation, pulmonary insufficiency
Mrs. A. B.	39	7/1/43		Yes	Rt. pneumo-nectomy	11 yrs.	15th	Embolism
Mrs. M. M.	32	5/3/43		Yes	Rt. pneumo-nectomy	2 1/4 yrs.	2nd	Circulatory failure
Miss M. F.	30	10/23/43		Yes	Rt. pneumo-nectomy	3 yrs.	Day of operation	Post-operative shock
Mr. J. G.	49	10/25/43		Yes	Rt. pneumo-nectomy	19 yrs.	19th	Pulmonary insufficiency

TABLE VII
ANALYSIS OF LATE DEATHS

Name	Age	Date of operation	Pre-op. classification Desp. risk	Reas. risk	Operation	Duration of illness	P.O. time of death	Cause of Death
Miss C. C.	28	2/23/35		Yes	Lt. pneumo-nectomy	14 mos.	6 mos.	Empyema, pneumonia, renal thrombosis, uremia
Miss V. D.	28	12/10/40		Yes	Rt. pneumo-nectomy	5 yrs.	19 mos.	Sudden death on street; cause unknown
Mrs. N. S.	34	9/11/41		Yes	Rt. pneumo-nectomy	10 yrs.	19 mos.	Died suddenly on 3rd day after plastic closure of bronchial fistula

preoperatively as a reasonable risk. Only one of three late deaths occurred in the reasonable risk group and this patient died fifteen months following operation, at which time sudden death occurred on the third day following a plastic closure of a bronchial fistula. As the tables show, only four deaths in the entire series can be attributed to the tuberculous infection. Five cases died of complications which were not related to the pulmonary tuberculous infection as such, but were related to the surgical problem of pulmonary resection. One of these cases died of pulmonary insufficiency on the fourth postoperative day. A second patient died suddenly of embolism on the fifteenth postoperative day. Up until this time her postoperative course had been entirely uneventful. A third case died of circulatory failure on the second postoperative day. A fourth patient died of postoperative shock two hours following operation. A fifth patient died of pulmonary insufficiency on the nineteenth postoperative day. All except the one who died of embolism were in very poor general condition.

PRESENT CLINICAL STATUS

The clinical status of the patients at the present time is as follows: Eleven have died. Of the remaining 19, 15 are clinically well. Of these 15 patients, 11 have been discharged from the sanatoria to their homes. The other four are still on bed rest either in the sanatorium or at home. One patient has a mixed tuberculous empyema and is awaiting thoracoplasty. One has ulceration of the bronchial stump and positive sputum. Recently this patient also developed a tuberculosis of the ilium and sacro-iliac joint. The two remaining patients have progressive contralateral lesions and will eventually die of tuberculosis.

The following is the data concerning the sputum examinations of the 19 living patients:

- 1) Four are positive by direct smear or concentration.
- 2) Twelve are negative by concentration
 - a) Three are also negative by culture
 - b) Two are also negative by guinea pig inoculation.
- 3) Two patients have had no sputum examinations since resection. The reason for this is listed in the sanatorium as "No cough or expectoration."
- 4) We have insufficient data to classify the one remaining case. However, she is well ten years following operation.

SURGICAL PATHOLOGY

The study of surgical specimens has enabled the pathologist to see the disease process in all stages of development as compared with autopsy studies where only late terminal types of disease are

seen. During the past year, Dr. William Meissner has studied the tuberculous lungs or lobes resected in the past ten years. Many significant facts regarding tuberculous bronchitis have come to light during this work. In the future, surgical pathology should enable us to understand better the disease process and to approach these cases with a more rational therapeutic program.

The actual incidence of tuberculous bronchitis by pathological study is much greater than that diagnosed bronchoscopically. Submucosal involvement with round cell infiltration and usually tubercle formation has been the earliest finding and has been present frequently when it was unsuspected. When ulceration or granulation tissue was present, the submucosal involvement was always more extensive, and the break in the mucosa merely represented that area where the bronchial disease had become an open focus. This is of significance because many times the bronchial amputation and suture lines are through an involved portion of the bronchus even when this is not suspected by either bronchoscopic or direct inspection. The draining bronchus of a cavity is involved almost without exception. This has been especially marked in lower lobe cavities, most of which are located in the superior division of this lobe. In most of these the draining bronchus has been extensively involved throughout and at times the entire bronchial mucosa has been destroyed and the bronchial lumen filled with caseous material. Many of these lesions will not be discovered by bronchoscopic examination as they are "around the corner" and are not visible. When resection is anticipated, however, and a cavity is present in this location, the draining bronchus should be considered to be involved. This brings up the question of whether a middle and lower lobectomy on the right side is not a more rational procedure for this type of lesion than a lower lobectomy. This would enable the bronchial suture line to be placed above the involved portion of the bronchial tree, and thus tend to avoid the complication of stump ulceration. This is one of the problems that time and more experience will have to answer.

The study of the parenchymal lesion in these cases has also been revealing. These have been characterized by the high incidence of basal disease, the extensiveness of the parenchymal lesion, and the tendency toward the bronchopneumonic type of tuberculous lesion. Examination of these specimens leaves little doubt that, should any of these cases be treated by any collapse measure, a large bulky mass of tuberculous lung would be collapsed and a huge amount of pathology remain as a threat in the future.

DISCUSSION

In 1942, Thornton and Adams reviewed the entire literature deal-

ing with pulmonary resection in pulmonary tuberculosis. Their review presented statistics on 29 pneumonectomies and 46 lobectomies, a total of 75 resections. A very high incidence of complications related to the tuberculous infection itself, such as persistent fistulae, empyema, and contralateral spread was reported. Their conclusions were as follows: "Resection of lung tissue is very hazardous in the presence of a positive sputum. If possible, collapse therapy is preferred." We, however, agree with Churchill and Klopstock that these conclusions are unwarranted because of the fact that this review of the literature represents a very heterogeneous group of cases operated upon with variable technique and often times without the diagnosis of pulmonary tuberculosis having been established prior to operation. In many of these cases tourniquet technique was used, and in our opinion the tourniquet is one instrument that has no place in the armamentarium of the surgeon performing resection for pulmonary tuberculosis. It has been our experience that the dissection of the hilum of the tuberculous lung can be dispatched with greater ease than when treating suppurative disease or cancer. This is due to the fact that usually mediastinal glands are small, cleavage planes are free, and anatomical structures are not distorted by the pathological process.⁴

In the light of recent experience with pulmonary resection for pulmonary tuberculosis, it can be stated that the modern technique of individual ligation of hilar structures and the meticulous closure of the bronchus with the reinforcing pleural flap has reduced two of the complications (fistula and tuberculous empyema) to a very low level. The third common complication, contralateral spread, is still a very definite threat. It has occurred in approximately 15 per cent of the entire resection series and in 15.8 per cent of the cases complicated by tuberculous bronchitis. An attempt is being made at the present time to overcome spilling at the time of operation by making the ligation of the bronchus a primary step in the resection. Recently, four resections (2 pneumonectomies and 2 lobectomies) have been performed under local anesthesia. A minimal spread was encountered in one of these cases. We are also anticipating the use of intrabronchial anesthesia which would permit the exteriorization of each lung and possibly prevent the intrabronchial spilling of secretions. This remains the one big problem to be solved in resection for tuberculosis. At present, it is the outstanding cause of failure. It is a challenge to the ingenuity of both the surgeon and anesthetist.

The question often arises as to whether resection can be safely performed through an involved area of the bronchus. This has been done on several of these cases and no fistulae have developed. Bronchial stump ulcers, however, have occurred in 21 per cent of

this series of cases, all of which had endobronchial tuberculosis prior to resection. This is a complication that must be reckoned with. It has been noted that most of these ulcers have occurred where the mattress sutures have been placed in the bronchus. For this reason, in the most recent resections, when feasible, mattress sutures have not been used. A shorter stump has thus been secured by using only end sutures in the bronchus. It is too early to tell whether or not this procedure will reduce the incidence of stump ulceration. Fortunately, local therapy with 30 per cent silver nitrate has given encouraging results in these cases.

The condition of the contralateral lung is of extreme importance and must be considered individually in each case. No definite criteria can be set up as to when a contralateral lesion will or will not contraindicate resection. If there is a receding lesion in the contralateral lung and the lesion in the lung to be resected is not progressive, time for more stabilization with bed rest may be given. If the lesion to be resected is threatening life, however, or progressing, resection is proceeded with and a chance is taken with the contralateral lesion. We do not agree with those who feel that the contralateral lung must be absolutely clear. Many of the cases in this series had evidence of a contralateral lesion and a few had considerable disease in the opposite lung at some previous time. Only three contralateral exacerbations have occurred.

The operative mortality has been reduced to an acceptable level in reasonable risk cases. In this series of 30 cases with endobronchial tuberculosis, the operative mortality in the reasonable risk cases is 5.5 per cent. Thus, given a patient who is in good general condition and who has been referred for operation before it is evident that he is a last resort case, pulmonary resection offers him a reasonably safe operation, with the possibility of getting rid of a tremendous amount of pathology in a very short time. The time has come to change our conception of pulmonary resection for pulmonary tuberculosis and to relegate the unwarranted fears of fistula and empyema to the past where they belong. Contralateral spread and bronchial ulceration are still two vital problems to be solved. These facts must be faced clearly.

The amount of lung tissue to be resected must be decided at the time of operation when the lung can be palpated. Not infrequently considerable tuberculosis is found in one of the lobes where it was not suspected, necessitating a pneumonectomy where a lobectomy had been planned. In cases where the endobronchial tuberculosis has involved the major bronchi, particularly when stenosis is present, pneumonectomy can be decided upon prior to exploration.

Pneumonectomy finds a greater place in the treatment of these cases with this complication than does lobectomy, because of the

location of the bronchial disease and the usual accompanying widespread parenchymal involvement. If possible, the bronchus should be amputated at a level above that where the bronchial disease is evident. Resection in these cases has two purposes: (1) to remove all of the parenchymal disease, and (2) to remove all of the bronchial lesion, if this can be done. On the right side, in the case of basal tuberculosis, lobectomy is more feasible than on the left side because oftentimes the intermediate bronchus is free of disease. This would permit a middle and lower lobectomy with the suture line above the diseased area, leaving behind a normal bronchus and a normal upper lobe. On the left side, lower lobectomy finds a very limited field in cases with bronchial lesions and is applicable only to those which have bronchial lesions well below the level of the superior division. These are rare.

CASE REPORTS

Figures 1a and 1b: Mrs. E. M. A 45-year-old female. Classified pre-operatively as desperate risk.

Figure 1a, upper left: Roentgenogram in 1938, showing lesion at left apex with small cavity. Patient treated with bed rest and phrenic. Pneu-

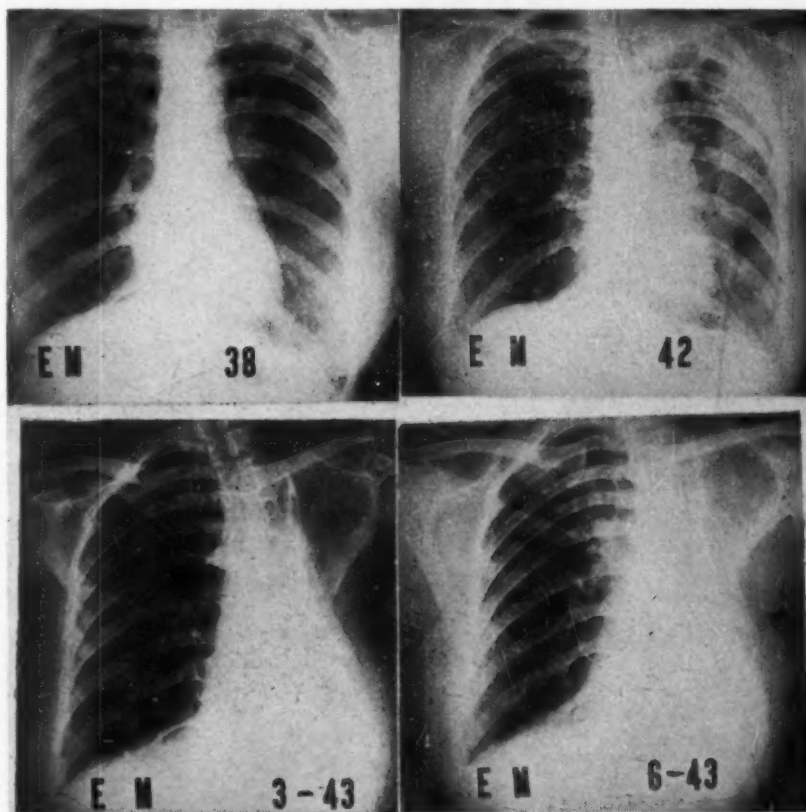


FIGURE 1a

mothorax impossible because of adhesions. Disease progressed slowly.

Figure 1a, upper right: Roentgenogram in 1942. Note retraction of mediastinum, increase in size of cavity and extension of disease. Lower lobe relatively clear. Three-stage thoracoplasty performed in June, July, and August, 1942. Postoperative course stormy. Left lung became opaque and nodular spread occurred to right lung. Sputum remained positive. Bronchoscopy revealed ulcerostenosis of left main bronchus.

Figure 1a, lower left: Roentgenogram in March, 1943, six months following thoracoplasty and just prior to pneumonectomy, which was performed on April 16, 1943. Note extensive nodular spread in right lung and appearance of collapsed lung.

Figure 1a, lower right: Roentgenogram two months following pneumonectomy. Lesions in right lung have not extended but appear more fibrotic.

Figure 1b: Surgical specimen has been cut in two planes. Upper lobe residual cavity is very small. Note extensive involvement of lower lobe, which was relatively clear on x-ray prior to thoracoplasty. This case demonstrates increase in disease beyond the bronchial stenosis commonly seen with any collapse procedure. Main bronchus and smaller bronchi of both lobes were markedly involved with an active tuberculous bronchitis.



FIGURE 1b

Patient still has slight cough and expectoration. Sputum is positive. Bronchoscopy reveals ulceration of bronchial stump. Recently extrapulmonary tuberculosis involving the ilium and sacro-iliac joint developed.

Figure 2: Mrs. G. T. A 35-year-old white female; duration of illness $3\frac{1}{4}$ years. Left pneumothorax had existed for three years. Fluid had been present on this side intermittently during two years prior to operation and had been shown to be positive for the tubercle bacillus. Preoperative bronchoscopy revealed a marked stenosis of the left main bronchus at its orifice with considerable granulation tissue present. Pneumonectomy was performed on June 21, 1943. In the postoperative period patient developed a Staph. aureus empyema which was drained by rib resection. Since then this space has been obliterated by thoracoplasty except for a narrow sinus tract. Fluid removed at the time of the empyema drainage was negative by guinea pig inoculation and

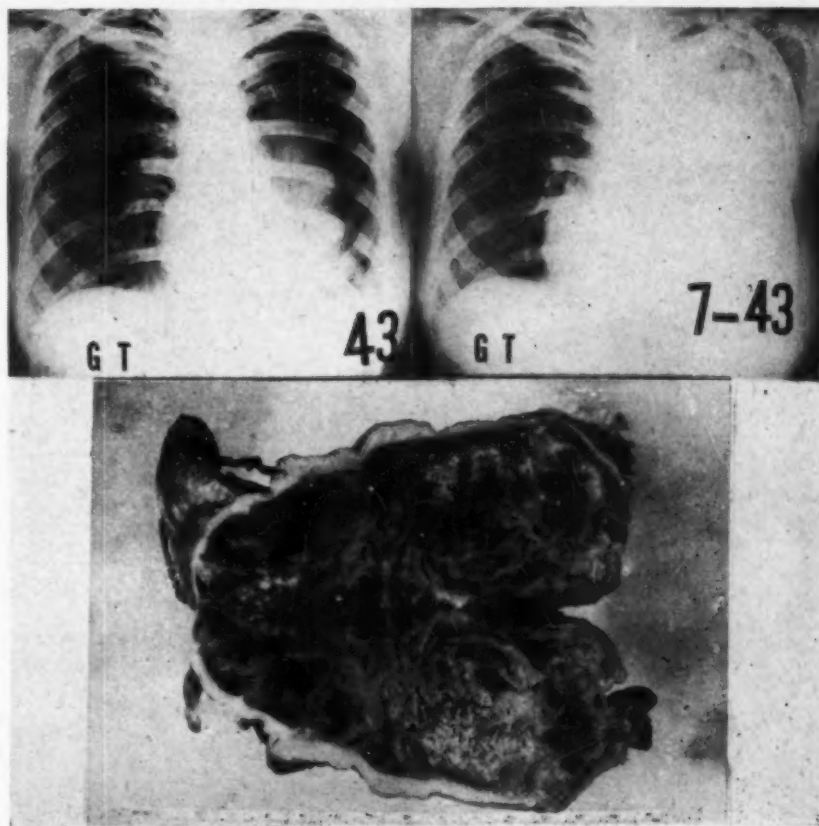


FIGURE 2

Upper left, reveals the preoperative film, showing the dense left lung under pneumothorax.—*Upper right*, shows the postoperative film before the drainage of the empyema space.—*Lower center*, shows the pathological specimen. Note the widely distributed involvement of the entire lung with caseous foci and the extensive fibrosis; also the markedly thickened pleura. Study of the surgical specimen revealed a one and one-half cm. cavity in the superior division of the lower lobe and scattered tuberculous nodules throughout both lobes.

biopsy of the parietal pleura failed to reveal any evidence of tuberculosis. At the present time this patient is asymptomatic and well. She is still in the sanatorium under observation. Her sputum is negative on smear and concentration.

Figures 3a and 3b: Miss J. Y. A 39-year-old female. Onset of tuberculosis in 1940. Classified preoperatively as reasonable risk.

Figure 3a, upper left: Roentgenogram of chest in September, 1940. Note basal distribution of disease, retraction of mediastinum, elevation of diaphragm and large cavity far out in 5th anterior interspace. Also small lesion in 3rd anterior interspace on right. Bronchoscopy in July, 1942, revealed ulcerostenosis of left main bronchus.

Figure 3a, upper right: Roentgenogram prior to resection. Pneumonectomy performed September 18, 1942. Postoperative course uneventful. Postoperative bronchoscopy 6 weeks after operation revealed normal bronchial stump.

Figure 3a, lower left: Roentgenogram 6 months postoperative. No contralateral increase noted.

Figure 3a, lower right: Roentgenogram in August, 1943, 11 months

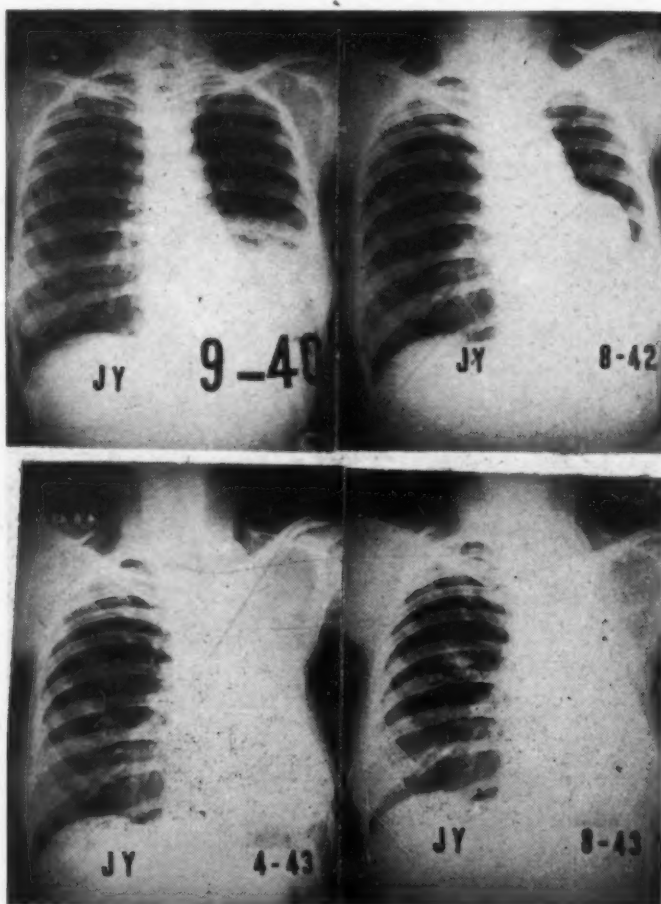


FIGURE 3a

postoperatively, showing contralateral increase adjacent to previous lesion on this side. Patient is asymptomatic and clinically well. Sputum negative on smear, concentration, and gastric. Secretions aspirated directly from the bronchial stump are also negative.

Figure 3b: Surgical specimen. There was extensive lower lobe disease with bronchiectasis. Note the marked involvement of upper lobe, which was relatively clear by x-ray in 1940.

Figure 4: Miss A. G. A 41-year-old white female; duration of illness ten months. Treated prior to pneumonectomy with left pneumothorax. Left lung became densely opaque following pneumothorax and bronchoscopy revealed an ulcerostenosis of the left main stem bronchus. Pneumonectomy was performed on March 25, 1941. Patient made an uneventful recovery from operation and has been completely well since. Her sputum is negative to all tests including culture and guinea pig inoculation of gastric washings.

The patient is now working full time and is completely asymptomatic. Her general condition is excellent.

SUMMARY

1) Data has been presented on 30 cases with endobronchial tuberculosis in which pulmonary resection has been used as a form of treatment. Of these 30 cases, 12 were desperate risks and 18 were reasonable risks. Patients facing an early fatal course were considered as desperate risks. Any salvage in this group was considered as pure gain.

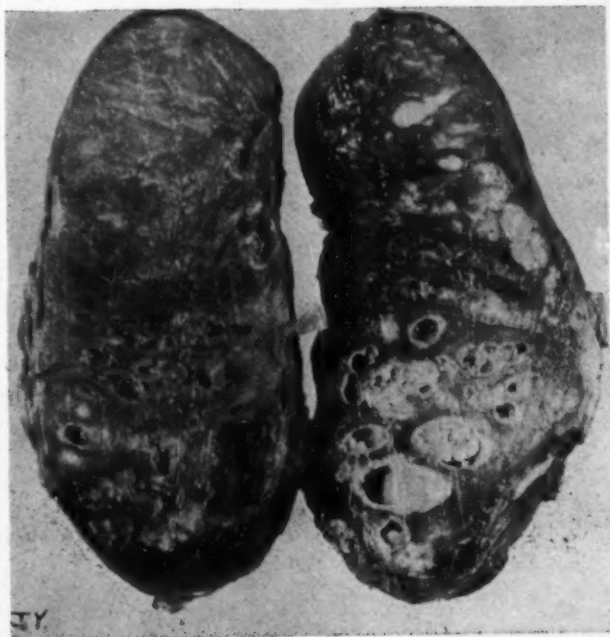


FIGURE 3b

2) The operative mortality in reasonable risks was 5.5 per cent and in desperate risks 58.3 per cent.

3) Tuberculous empyema and permanent fistula were eliminated as complications of pulmonary resection in all except one of the 19 patients treated after January, 1942, when individual ligation technique was employed and the bronchial stump was routinely reinforced with pleura.

4) Ulceration in the bronchial stump and contralateral spread were the most common complications and continue to challenge the thoracic surgeon.

5) Tuberculous bronchitis, either active or inactive, which must be traversed in doing a resection, is not within itself a contra-

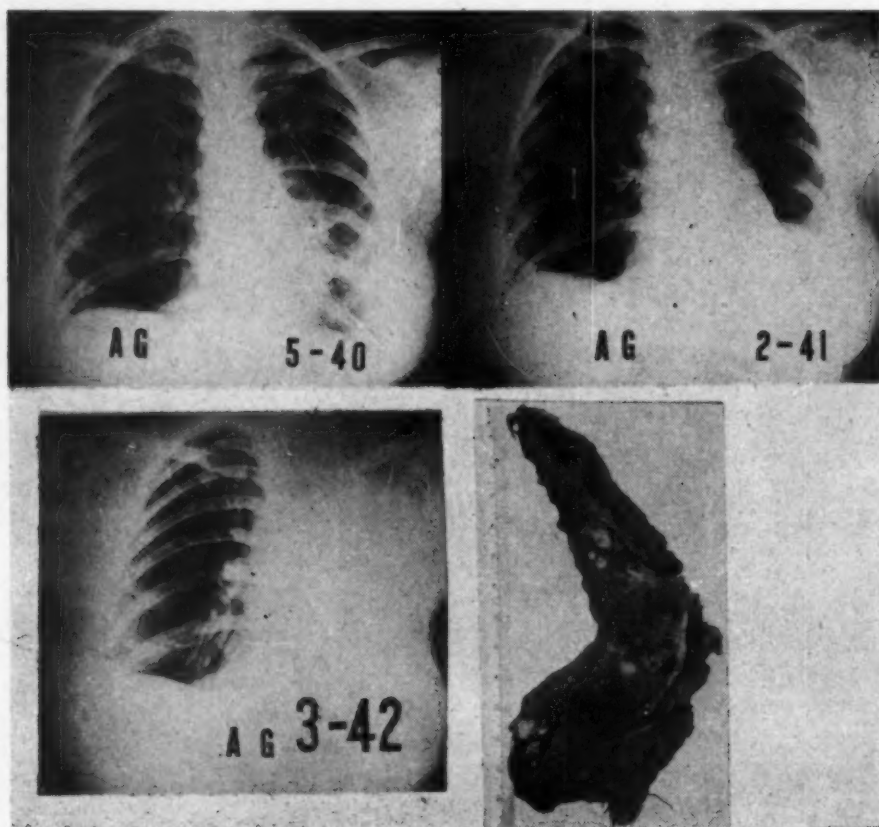


FIGURE 4

Upper left, shows the patient's x-ray at the time of admission to the sanatorium in May, 1940. Note the predominantly basal distribution of the lesion.—*Upper right*, shows the patient's x-ray just before pneumonectomy. The left lung has become densely opaque.—*Lower left*, shows the postoperative x-ray approximately one year following operation. This patient was last seen at the sanatorium in January, 1943, at which time her x-rays revealed no changes compared with this film.—*Lower right*, shows the pathological specimen. The pathological study revealed numerous caseous nodules scattered throughout the lung.

indication. On the contrary this complication often is an indication for resection.

6) Active tuberculosis in the lung to be resected, even if it is rapidly spreading, is not a contraindication to resection. In fact, delay may rob these patients of their only chance to get well.

7) A contralateral lesion in itself is not a contraindication to resection, unless this lesion is uncontrolled or uncontrollable.

CONCLUSIONS

The experience of the past few years has shown us how utterly mistaken we have been about performing surgery on tuberculous tissue. Improved operative technique has almost eliminated two of the great hazards of a few years ago—namely, fistula and tuberculous empyema. The high incidence of these complications in the past has not been due to the tuberculous infection *per se* but to improper technique. Contralateral spread remains the great hazard to the tuberculous patient facing resection today. Different surgical and anesthetic procedures are now being tried in an attempt to overcome the spilling of secretions during the operative procedure which is the cause of this complication.

Any report on pulmonary resection in the treatment of tuberculosis must at this time be considered a preliminary one. Because of the nature of the disease being treated, time and careful follow-up of patients will eventually show us the true value and the proper place of this procedure. Thus, until further experience has been gained, it should be used with great caution.

Resection of lung tissue, especially for tuberculosis, is a formidable operative procedure. It should be performed only by those with considerable experience with this type of surgery and only when all therapeutic adjuncts are available. The service of a well-trained physician anesthetist is imperative.

The failures and complications of collapse procedures should be anticipated in patients with bronchial disease, particularly when the danger signs of ulceration and stenosis are present. The need at present is to discover these complicated cases early and to do the resection before the patients have become desperate risks.

Resection should not be considered as a competitive, but rather as a supplementary type of therapy to the other well-established forms of treatment. Pulmonary resection in the future will become a valuable addition to our armamentarium in the treatment of certain forms of pulmonary tuberculosis with or without a complicating tuberculous bronchitis.

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Brookline, Mass.

Resumen

1) Se ha presentado datos sobre 30 casos con tuberculosis endobronquial en los cuales se empleó la resección pulmonar como tratamiento. De estos 30 casos, 12 eran riesgos operatorios desesperados y 18 eran riesgos medianos. Se consideraron riesgos desesperados a aquellos pacientes en quienes se esperaba un desenlace fatal cercano. Todo caso salvado en este grupo se consideró como ganancia pura.

2) La mortalidad de operados en los riesgos medianos fue de 5.5 por ciento y en los riesgos desesperados de 58.3 por ciento.

3) Se eliminó el empiema tuberculoso y la fístula permanente como complicaciones de la resección pulmonar en todos, excepto uno, de los 19 pacientes tratados después de Enero de 1942, en los que se empleó la técnica de ligación individual y se reforzó sistemáticamente el muñón bronquial con pleura.

4) Ulceración del muñón bronquial y propagación contralateral fueron las complicaciones más comunes, y continúan desafiando al cirujano del tórax.

5) La bronquitis tuberculosa, ya sea activa o inactiva, que es necesario atravesar para ejecutar la resección, no es por sí misma una contraindicación. Por el contrario, esta complicación indica a menudo que debe hacerse la resección.

6) La tuberculosis activa en el pulmón que se va a extirpar, aunque se esté propagando con rapidez, no contraindica la resección. En realidad, la dilación puede quitar a estos pacientes su única oportunidad de curarse.

7) Una lesión contralateral, por sí misma, no contraindica la resección, a no ser que esta lesión no esté dominada o no sea dominable.

Conclusiones

La experiencia de los últimos pocos años nos ha demostrado el gran error que hemos estado cometiendo al ejecutar operaciones en tejidos tuberculosos. El perfeccionamiento de la técnica operatoria casi que ha eliminado dos de los grandes riesgos de hace unos pocos años, a saber: la fístula y el empiema tuberculoso. La alta frecuencia de estas complicaciones en el pasado no se ha debido a la infección tuberculosa misma sino a técnica impropia. La propagación contralateral todavía es hoy el mayor riesgo operatorio de la resección pulmonar por tuberculosis. Actualmente se están ensayando diferentes procedimientos quirúrgicos y anestésicos a fin de eliminar el derrame de las secreciones durante la operación, que es la causa de esta complicación.

Al presente, cualquier informe sobre la resección pulmonar en el tratamiento de la tuberculosis debe considerarse un informe preliminar. A causa de la índole de la enfermedad bajo tratamiento, sólo el tiempo y la cuidadosa observación subsecuente de los pacientes nos demostrará finalmente el verdadero valor y la exacta posición de este procedimiento. Así es que debe emplearse con gran prudencia hasta que se haya adquirido mayor experiencia.

La resección de tejido pulmonar, especialmente por tuberculosis, es un procedimiento operatorio formidable que debe ser ejecutado únicamente por aquellos que tengan considerable experiencia en este tipo de cirugía, y solamente cuando todos los auxiliares terapéuticos indispensables se encuentren a su disposición. Los servicios de un médico experto en la anestesia son imprescindibles.

Se debe prever fracasos y complicaciones de la colapsoterapia en pacientes con lesiones bronquiales, especialmente cuando existan signos indicativos de ulceración y estenosis. Urge al presente que se descubra tempranamente a estos casos complicados y que se lleve a cabo la resección antes de que los pacientes se conviertan en casos desesperados.

No se debe considerar la resección una terapéutica competidora sino más bien suplementaria a los otros tratamientos ya establecidos. La resección pulmonar llegará a ser en el futuro una adición valiosa al tratamiento de ciertas formas de tuberculosis pulmonar, complicada o no por la bronquitis tuberculosa.

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JAY ARTHUR MYERS, M.D., F.C.C.P.

President

1944-1945

President's New Year Message

As a last word on the subject of tuberculosis to the general practitioner, Osler said: "The leadership of the battle against this scourge is in your hands. Much has been done; much remains to do. By early diagnosis and prompt, systematic treatment of individual cases, by striving in every possible way to improve the social condition of the poor, by joining actively in the work of the local and national tuberculosis societies, you can help in the most important and the most hopeful campaign ever undertaken by the profession."

When the American College of Chest Physicians was organized, its most appealing project was to restore the general practitioner to his rightful place in the diagnosis, treatment and prevention of tuberculosis. It was recognized that approximately 30 million persons are examined in hospitals and probably an additional 20 million in physicians' offices each year and that the general practitioner does the lion's share in this work. To equip him with the latest information and the complete armamentarium for combatting tuberculosis was a most laudable undertaking. This was a niche which had not been filled in the tuberculosis field. One of the important steps in attaining this goal was to have meetings of the various chapters of the College held in conjunction with district and state medical associations, and the annual meeting of the College with the American Medical Association. Already this has done much to stimulate the interest of the medical profession in tuberculosis. Another important step was to provide a journal for the publication of practical articles on the various diseases of the chest. From a small beginning this journal, now under the editorship of Dr. Ralph Matson, has evolved into one of the best of its kind. One of the most important projects that has been proposed is that by Dr. E. W. Hayes, Chairman of the Council on Undergraduate Medical Education of the College, for the publication of a book to include the essentials of diagnosis, treatment and prevention of chest diseases for medical students. This should aid greatly in preparing the oncoming generation of doctors in this field.

The predicted increase in mortality from tuberculosis throughout the United States for 1943 and 1944 did not occur, but there is good reason to believe that the inability to operate all of our sanatoriums and hospitals as efficiently as in the past, through decrease of personnel and the increase in exposure to contagious cases of tuberculosis of our men and women in military service in those parts of the world where the tubercle bacillus is well-nigh ubiquitous has resulted in much more than the usual seeding of tubercle bacilli. The crop has not had time to mature, but it will yield a large harvest in subsequent years.

Tuberculosis is so prevalent in the world that even before the present war it caused more disability and death than any other disease, except in the occasional year when it was superseded by malaria. With the unleashing of tubercle bacilli in so many parts of the world incident to the war, there has occurred a tremendous seeding and reseeded of human bodies, which must soon result in an increased morbidity. It is therefore exceedingly fortunate that the American College of Chest Physicians has become well organized and its chapters are widely distributed in many parts of the world, particularly the western hemisphere. Qualifications for membership are so high that only especially well trained physicians are admitted. Therefore this organization is now in a splendid position to serve as a stabilizing agent in tuberculosis control. It should assume the responsibility of protecting the public against fads and fancies, short-cut and slipshod methods. It is in a position to recommend to all the most effective procedures in the diagnosis, treatment and prevention of tuberculosis.

Tuberculosis is a world-wide problem. It no longer suffices to control the disease in one's community, state or nation, without at the same time assisting in its control in other nations. In this country we are in a splendid position to support the tuberculosis control program of the United States Public Health Service, directed by Dr. H. E. Hilleboe and to cooperate with all other organizations in the field of tuberculosis. Duplication of effort should be avoided, as there is work for all, and more work than all can do.

As great as the tuberculosis problem is, the American College of Chest Physicians does not limit its activities to this disease. It has other weighty problems to help solve, such as malignant and benign tumors of the chest, pneumoconiosis, fungus infections, pneumonia, suppurative conditions, et cetera.

As 1944 closed, the American College of Chest Physicians could look back with pride upon its accomplishments. As 1945 begins, although we are faced with momentous problems, the medical profession is in a better position to solve them than at any previous time in history. If each of us works diligently in his own sphere, disseminates information to others, participates in the activities of other organizations in the same field, and consciously searches for truth, greater success will be achieved in controlling diseases of the chest.

SEMI-ANNUAL MEETING OF THE BOARD OF REGENTS AMERICAN COLLEGE OF CHEST PHYSICIANS

HOTEL DeSOTO, ST. LOUIS, MISSOURI

November 13, 1944

The following resolutions were introduced and adopted by the Board of Regents:

1. That physicians in addition to the requirements for membership as now set forth in the By-Laws of the American College of Chest Physicians must devote a minimum of fifty per cent (50%) of their professional activities to diseases of the chest organs in order to be eligible for *Fellowship* or *Junior Fellowship* in the College. Other physicians who have established their interest in diseases of the chest and who are able to meet the minimum requirements of the College may become *Affiliates* of the College by application.

The above resolution, in accord with the By-Laws, is being published in the official journal of the College and will be voted upon by the membership at large at the next annual meeting to be held in Philadelphia, June 16-19, 1945. Should the resolution be adopted, Associate Fellows will become Junior Fellows and Associate Members will become Affiliates of the College.

2. Dr. Nelson W. Strohm, Buffalo, New York, introduced a plan proposed by Dr. George Foster Herben, Governor of the College for New York State, concerning postgraduate medical education for physicians who are released from the armed services into civilian life. The plan was acted upon favorably by the Board of Regents and referred to the Council on Postgraduate Medical Education.
3. The Union of Latin American Societies Against Tuberculosis (ULAST) will hold its Sixth Annual Congress at Havana, Cuba, January 15-21, 1945. An invitation was received from Dr. Juan J. Castillo, F.C.C.P., Havana, Cuba, President of the Congress, asking that the American College of Chest Physicians send an official delegation to this Congress. The Board of Regents authorized Dr. Jay A. Myers, President of the College, Dr. Chevalier L. Jackson, Chairman, Council on Pan-American Affairs, and Mr. Murray Kornfeld, Executive Secretary of the College, to attend the Congress at Havana, Cuba, as official delegates of the American College of Chest Physicians.
4. A resolution previously adopted by the Board of Regents to increase the annual dues in the College to \$12.50 for the duration of the war was rescinded and the dues for the year 1945 will remain at the present fee of \$10.00 per year.
5. Because of the recent organization of College Chapters, and for a more equitable distribution of regional districts to conform with the chapters established by the College, the following states have been regrouped into regional districts to become effective June 15, 1945:
 - 1 New England States.
 - 2 New York State.
 - 3 Pennsylvania, New Jersey, Delaware.
 - 4 Maryland, Virginia, West Virginia, District of Columbia.
 - 5 Florida, Georgia, North and South Carolina.
 - 6 Michigan and Ohio.
 - 7 Indiana and Illinois.
 - 8 Arkansas, Kansas, Missouri and Oklahoma.
 - 9 Alabama, Kentucky, Tennessee, Mississippi and Louisiana.
 - 10 North and South Dakota, Wisconsin, Iowa, Minnesota and Nebraska.
 - 11 Colorado, Utah, New Mexico and Wyoming.
 - 12 Texas.
 - 13 Arizona, California and Nevada.
 - 14 Oregon, Idaho, Montana and Washington.
6. That an engraved certificate for life membership in the American College of Chest Physicians be prepared by the Chairman of the Board of Regents and that these certificates be issued to Fellows of the College whose application for life membership have been approved by the Board of Regents, and that these certificates be numbered in the order in which the applications are received at the executive offices of the College.

Reports of Councils and Committees

The following councils and committees presented preliminary reports of progress to the Board of Regents:

- 1) Financial Report, Paul H. Holinger, M.D., F.C.C.P., Chicago, Illinois, Secretary-Treasurer.
- 2) Council on Undergraduate Medical Education, E. W. Hayes, M.D., F.C.C.P., Monrovia, California, Chairman.
- 3) Council on Postgraduate Medical Education, J. Winthrop Peabody, M.D., F.C.C.P., Washington, D. C., Chairman.
- 4) Council on Military Affairs and Public Health, Charles M. Hendricks, M.D., F.C.C.P., El Paso, Texas, Chairman.
- 5) Council on Sanatorium Standards and Administration, Benjamin L. Brock, M.D., F.C.C.P., Waverly Hills, Kentucky, Chairman.
- 6) National Council of Tuberculosis Committees, James H. Stygall, M.D., F.C.C.P., Indianapolis, Indiana, Chairman.
- 7) Membership Committee, Major General S. U. Marietta, M.C., F.C.C.P., Washington, D. C., Vice Chairman.
- 8) Committee on Occupational Diseases of the Chest, Louis Mark, M.D., F.C.C.P., Columbus, Ohio, Chairman.
- 9) Committee on State Laws for Tuberculosis, Andrew L. Banyai, M.D., F.C.C.P., Wauwatosa, Wisconsin, Chairman.
- 10) Scientific Program Committee, Minas Joannides, M.D., F.C.C.P., Chicago, Illinois, Chairman.
- 11) Ways and Means Committee (Diseases of the Chest), J. Winthrop Peabody, M.D., F.C.C.P., Washington, D. C., Chairman.
- 12) Board of Examiners, H. I. Spector, M.D., F.C.C.P., St. Louis, Missouri, Chairman.

* * * * *

Charles L. Harrell, M.D., F.C.C.P., Norfolk, Virginia, representing the Society of Chest Physicians of Virginia, asked the Board of Regents for an expression of opinion concerning the affiliation of that society with the American College of Chest Physicians and establishing a chapter of the College in the state of Virginia. Dr. Peabody introduced a resolution extending an invitation to those members of the Society of Chest Physicians of Virginia who are not now members of the College to apply for such membership. The Governor of the College for the state of Virginia is authorized in the College By-Laws to pass upon such applications and the Board of Regents agreed to give every applicant due consideration. The resolution was unanimously adopted.

The following Regents attended the meeting:

Dr. Joseph C. Placak, Cleveland, Ohio, *Chairman*
 Dr. Andrew L. Banyai, Wauwatosa, Wisconsin
 Dr. Edward W. Hayes, Monrovia, California
 Dr. Charles M. Hendricks, El Paso, Texas
 Dr. Paul H. Holinger, Chicago, Illinois
 Major General S. U. Marietta, Washington, D. C.
 Dr. Louis Mark, Columbus, Ohio
 Dr. Jay A. Myers, Minneapolis, Minnesota
 Dr. William E. Ogden, Toronto, Ontario, Canada
 Dr. Richard H. Overholt, Brookline, Massachusetts
 Dr. J. Winthrop Peabody, Washington, D. C.
 Dr. H. I. Spector, St. Louis, Missouri
 Dr. Nelson W. Strohm, Buffalo, New York
 Dr. James H. Stygall, Indianapolis, Indiana
 Dr. Paul A. Turner, Louisville, Kentucky

COMMITTEES MEET TO DISCUSS ORGANIZATION OF SPECIALTY BOARD

A joint meeting of committees representing the American Association for Thoracic Surgery, the American Broncho-Esophagological Association and the American College of Chest Physicians was held at the DeSoto Hotel, St. Louis, Missouri, November 14, 1944. Lt. Col. Richard H. Meade, Jr., M.C., Evarts A. Graham, M.D., F.C.C.P. and Jerome R. Head, M.D., F.C.C.P., represented the American Association for Thoracic Surgery; Paul H. Holinger, M.D., F.C.C.P., and Gabriel Tucker, M.D., represented

the American Broncho-Esophagological Association; J. Winthrop Peabody, M.D., F.C.C.P., Charles M. Hendricks, M.D., F.C.C.P., and J. C. Placak, M.D., F.C.C.P., represented the American College of Chest Physicians. Others who attended the conference in an advisory capacity were: Major General S. U. Marietta, Drs. E. W. Hayes, G. A. Hedberg, William A. Hudson, Louis Mark, Jay A. Myers, H. I. Spector, and Mr. Murray Kornfeld, Executive Secretary of the College.

Dr. Peabody, Chairman of the Committee, appointed by the American College of Chest Physicians to survey the possibilities for establishing a Board on Diseases of the Chest, called the meeting to order and explained the purpose of the conference. Letters from the officials of the American Heart Association and the American Trudeau Society were introduced and recorded in the proceedings of the meeting. After a lengthy discussion, the following resolution was introduced by Dr. Head: Resolved, that it be the concensus of opinion of the representatives of the societies assembled at this conference, that the American College of Chest Physicians, the American Trudeau Society, the American Association for Thoracic Surgery, and the American Broncho-Esophagological Association should appoint committees to meet jointly with the Advisory Board for Medical Specialties in order to discuss the question under consideration. This resolution was unanimously adopted and the meeting was adjourned.

CHAPTER MEETINGS

Cuban Chapter

The Cuban Chapter of the College is planning to hold a meeting of the members of the College from all of the Latin American republics who will attend the Congress at Havana. Plans for the further development of College activities in the other American republics will be discussed at the conference being arranged under the auspices of the Cuban Chapter.

Southern Chapter

The Second Annual Meeting of the Southern Chapter of the College was held at St. Louis, Missouri, November 13-14, 1944, jointly with the annual meeting of the Southern Medical Association. An excellent scientific program was presented under the chairmanship of Dr. Paul A. Turner, Louisville, Kentucky. The members of the Missouri Chapter of the College were the hosts for the meeting and the comforts of the visiting members were well taken care of by the Arrangements Committee under the chairmanship of Dr. H. I. Spector. Dr. Herman E. Hilleboe addressed the dinner meeting and presented the Tuberculosis Control Program of the U. S. Public Health Service. He spoke for nearly one hour and he discussed the program in great detail. The following officers were elected by the Southern Chapter of the College for 1944-1945:

Alvis E. Greer, M.D., F.C.C.P., Houston, Texas, President.

Carl C. Aven, M.D., F.C.C.P., Atlanta, Georgia, First Vice-President.

Paul A. Turner, M.D., F.C.C.P., Louisville, Kentucky, Second Vice-President.

Benjamin L. Brock, M.D., F.C.C.P., Waverly Hills, Kentucky, Secy.-Treasurer.*

*Re-elected.

There were 138 physicians registered at the Hotel DeSoto for the College meeting.

New York State Chapter

The New York State Chapter of the College will meet at the Hotel Biltmore, New York City, February 2, 1945. The following program has been arranged for this meeting:

Morning Session

James H. Donnelly, M.D., F.C.C.P., Buffalo, New York, *Presiding*, President. New York State Chapter.

"Diagnosis and Management of Suppurative Diseases of the Chest,"
Adrian A. Ehler, M.D., Albany, New York.